THE

ELECTRICAL REVIEW.

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1893,

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THE ELECTRIC LIGHTING OF RAILWAY CARRIAGES.

UNDER the above title will be found, in a recent issue of our contemporary, the *Engineering Review*, an inspired article, from which we learn that to the Metropolitan District Railway Company belongs the credit of being the first to adopt a system of electric lighting which supplies a reading light near the reader's book, and which, "while it does not call for any expenditure of capital by the railway company, gives the travelling public just what is wanted." The great boon which the Metropolitan District Company is thus about to bestow upon the passengers, is the provision in each of the corner compartments of its carriages of a small reading light, controlled by "a machine invented by Mr. Pourtel for retailing electric light to passengers by pennyworths." It is added that a few of these lamps have been in use experimentally on the same line of railway for the past two years, with satisfactory results, and that, as a result, the railway company has entered into arrangements with the Railway Electric Reading Lamp Company, of No. 1, Great Winchester Street, E.C., to instal up to 10,000 of the lamps. Thus, in a short time, passengers on the District Railway will have the pleasure of a reading light for half-an-hour on sacrificing one penny.

We very heartily congratulate the District Company's travelling public, and we no less heartily congratulate the railway company in having so felicitously fallen upon a means of meeting a recognised want at no cost to themselves. It is to be hoped the travelling public will, in their turn, show a reasonable appreciation of the thoughtful consideration of the company, and that they will haste to fill the coffers of the Reading Lamp Company in recognition of their efforts to administer to their comfort. Doubtless there will still be, even on the District Railway (the management of which is so anxious for the well-being of their clients), those who will not recognise the company's solicitude, and who will assert that it is the duty of the company to provide a light suitable to the requirements of their passengers, and we very much fear there will, as the novelty of the thing wears off, be many of these. It is, perhaps, too much to expect that more than a few, perhaps a very few, residential passengers travelling to and fro daily will add to the cost of their annual ticket even the trifling sum of some thirty shillings a year for the pleasure of reading the evening paper. The entire thing is a venture upon very treacherous ground. A reading light to a suburban residential traveller wending his way homewards is an undisputed boon, one which he will readily and fully appreciate, if provided by the railway company; but it will be a very different thing when it has to be paid for. Although a desirable thing, it is not indispensable; although a need, it is yet a luxury, and can be dispensed with—with grumbling at the niggardliness of the com-

pany for not providing the light free of cost. With long journey trains the case would be somewhat different. Such journeys are not daily journeys. Where a man will, from principle, or other equally sound reason, decline to support that which occurs daily, he will welcome it for the special occasion which takes him the long journey. To many, the daily demand for even one penny, will, viewed from a certain standpoint, assume the aspect of a daily tax. We trust such sentiments will not prevail, and that the lighting company may be able to carry out their proposals in such a manner as will insure perfect success in the amount of light to be afforded. If this is assured, one good will have been secured—the advantage of the electric light for the purpose in view will have been further demonstrated and one step more towards its final adoption will have been secured. While we recognise many difficulties to be overcome before the scheme can be completed, and while we doubt very much whether the lighting company will ever see the handsome return for their outlay which the concluding paragraph of the article referred to suggests, we very heartily wish the company success.

It would appear from our contemporary, that although there are difficulties in the way of a general application of electric lighting from the roof of carriages, it is thought that the introduction of the reading lamp will open the way, "as it will doubtless be found possible to light electric roof lamps of moderate power from the reading lamp batteries, and to do so at a less annual cost to the railway companies than is entailed by the use of either oil or gas, and without any capital outlay on the part of the railway companies."

Railway companies, with such prospects before them, may well join us in wishing success to the Railway Reading Lamp Company. To relieve them in the same breath of the cost of providing, not merely a reading light for their passengers, but also of some portion of the cost of the present roof lamp, is a boon of which the lighting company may be sure railway companies will not be slow to avail themselves. All that remains is for the former to show to what extent the company can fulfil their anticipations. So far as we understand the proposal at present, it involves the provision of the reading lamps at "one penny per half-hour." The illuminating power of the lamp is to be 3 candle-power. There are to be four lamps in each compartment, say 16 to 20 in each carriage, all of which are to be connected in parallel circuit with the accumulator. The lamps are to be worked at a pressure of 12 volts. The accumulator is to consist of six cells, coupled in series, having a capacity of 72 hours. The cells will be changed daily, duplicate sets being provided for each carriage.

The District line is a very suitable line, in respect of mileage and termini, for such an experiment. One charging station is all that is required, and will probably, under the arrangements proposed for connecting up and re-distributing the accumulators, meet the case; but it will, we fear, prove somewhat cumbrous and laborious. The daily transfer of such a mass of accumulators as will be required for the proposed 10,000 lights, viz., some 600 sets of six cells, first to and from the respective coaches, then to and from the truck in which they are to be sent to and taken from the charging station, together with the haulage of the trucks over the line of railway, to and from the charging depôt, will not prove a light matter, even for the reading lamps, but what *will* it be when the roof lamp is added? Practically, it will mean doubling the work. It is clear we must not be too sanguine with respect to the roof lamps, but wait the development of the reading lamps. If supported by the travelling public, the system will have, on the District line, every opportunity of showing its value; for it is clear it can be more economically worked on such a line than on any of the larger railway systems.

NIAGARA.

Things are progressing favourably at Niagara Falls. Of the two schemes for the utilisation of some of the inexhaustible supply of power of that source, that of the Cataract Construction Company, on the American side of the Falls, is in the most advanced stage. On the opposite side, the Canadian Power Company is engaged in developing the plans of Ferranti and Prof. Forbes, the present intention being to construct a tunnel laterally across the stream below the head waters, and close to the Falls, taking the water from the river by means of a number of vertical pipes, which will pass through the roof of the tunnel to the bed of the river exactly overhead. After passing through a number of large Pelton wheels, coupled direct to Ferranti dynamos of the Deptford type, the water will be discharged into branch tunnels leading from the main tunnel to the cliff directly under the Falls. It is expected that operations will be commenced early next spring. On the American side the tunnel, which is about 2¾ miles long, is approaching completion. This tunnel, which is to serve as a tail-race for about 100,000 H.P., will discharge some 10,000 cubic feet of water per second into the lower river at a short distance below the Falls. Passing under the town of Niagara, the tunnel extends parallel with the course of the river to about two miles above the Falls, at which point the river is navigable. Along this course several canals will conduct water from the head level, distributing it to the numerous wheel pits, which will be sunk from the canal banks to the tunnel below. At the bottom of these pits the turbines will be placed. Two modes of obtaining power will be available to the power user. He may either put in his own engines and wheel pits, discharging water into the main tunnel at a rental, or he may obtain electric power from the Niagara Falls Power Company, the generating station of which will commence operations by taking 10,000 H.P. from the canals, but which are designed to take an ultimate supply of 50,000 H.P. Two 5,000 H.P. turbines, designed by Faesch & Piccard, of Geneva, are already being installed; these, turning on long vertical shafts, will work without gearing, having attached to the top of each shaft a dynamo, which is designed to work horizontally. The immense weight of the dynamo and engine is partly taken from the step by supplying the water below the engine, and discharging it upwards. The many difficulties which have been met with in designing and carrying out this great scheme are not incidental to the head of water, for far higher heads are being utilised, but to the vast volume of water which has to be controlled under that head. The Niagara head, at best, is only 205 feet, and the head to be utilised will not exceed 140 feet; while at such falls as that met with on the Comstock lode, falls of 1,680 feet are developed, involving water pressures exceeding 700 lbs. per

square inch, and a peripheral speed in the wheels of more than 3½ miles a minute.

Originally, it was intended to excavate the American tunnel for the purpose of developing 120,000 H.P., the sides of the tunnel not being lined with any protective material; but it has been decided to protect the tunnel with a 16-inch lining of brickwork, notwithstanding that this will reduce the capacity by about 20,000 H.P. The company is to be congratulated on this timely decision; for, however much it may appear to be a loss of capacity in the plant, we have no doubt that the change will result in a net gain. Judging from some photographs we have seen in the *Electrical World*, the inrush of spring water is both copious and forcible, and would alone seriously reduce the capacity of the tunnel; while it is clear, from the nature of the strata—slates and shale—that the scouring of the water against the natural rock would cause considerable depreciation and perhaps serious breakdowns. Lined with good bricks, the tunnel is a permanent engineering job, and may be expected to more than recoup the lost H.P. by the saving in repairs and the reduction of the chances of failure.

Those who look on the æsthetic side of this scheme have been troubled as to whether the grandeur of the panorama will be diminished by the "ruthless utilitarianism" which will rob the Falls of about 3½ per cent. of the water; but, we can assure them, the effect of this on the level of the crest is inconsiderable. It is doubtful whether as much, or as little, can be said for the effect on the lower level. Comparing the channel above the stream with that immediately below, we find that the water is only carried through a constricted passage in the lower river by virtue of the enormous momentum which the fall produces. The duty of the turbines will be to rob the water of as much of this momentum as possible; and the *result will be a rise in the level of the bottom waters*. With the present tunnel we may not expect a rise of more than 2 or 3 feet at most; but any attempt to utilise a considerable fraction of the power of the Falls would involve the serious enquiry as to whether the natural channel of the lower river would be capable of carrying away the impeded stream without dangerous rise in the level of the river for several miles below the Falls. This, we think, will prove the greatest obstacle in the way of any considerable further utilisation of the power of this great natural source.

Engineering Examination Papers.

In a recent leading article the *Engineer* discussed the examination of the Science and Art Department of South Kensington, and stated emphatically that the certificates are "not worth the paper they are written on." We thoroughly endorse this opinion, and remember when, years ago, a friend presented himself for examination in a branch of engineering, but was ignominiously floored, since three out of five questions given required a knowledge of formulæ beyond his powers of memory. We have had but few occasions to use these same formulæ during a varied practice extending over some 15 years, and fail to see how such questions can be a fair test of an engineering student's ability; but they certainly play into the hands of the professional "crammers," who, by watching the peculiarity of the examiners, can easily foresee the kind of question likely to be set. Our contemporary refers to the Oxford and Cambridge local examinations, and also to those of the College of Preceptors; but omits to mention the City and Guilds of London technological certificates. Yet we believe most of the successful younger engineers hold the latter. We doubt whether any examination can test the real worth of a man, and certainly the training at college will not make an engineer, unless the lad has an aptitude for the work. But it is also equally true that no engineer is likely to rise very high in the profession now-a-days unless he be fairly well versed in physics, applied mechanics, &c.; and so the value of technical education, rightly understood, cannot be over-estimated for the ordinary student. But it must be subordinated to the workshop in the early stages, or the training will not be thorough. The certificates in themselves are of little importance, except that they show that the holder has attended certain lectures and gone through a definite course of study with evident profit to himself.

The Dielectric Constant of Liquid Conductors.

In the *Journal de Physique* (June, 1892), there is an interesting paper by W. Stschegtiaeff, a member of the Russian Physico-Chemical Society, on the determination of the dielectric constant of conducting liquids. He points out the advantage of using electrical oscillations of as short a period as possible, or of arranging the experiment so that errors of observation may mutually compensate each other, in this way avoiding mistakes owing to the properties of absorption and conductivity possessed by the liquid. Of these two plans preference is given to what may be termed the compensation method. The apparatus used in the experiments described was as follows:—A condenser consisting of three discs, two of which are fixed vertically at 5 mm. distance from each other, whilst the third can be displaced parallel to itself. This last disc and one of the two fixed discs are connected with the electrodes of a Rhumkorff coil, whilst the centre disc is "earthed" through a small incandescent lamp (5 volts) the filament of which has been fractured. [The lamp therefore acts like a Geissler tube.] This apparatus constitutes an extremely sensitive arrangement to electrical oscillations, the presence of which is shown by a glow in the lamp whilst the static discharge of the condenser produces a spark. If the two end discs are not arranged so as to form two condensers of equal capacity with that of the central disc, the latter is charged and the lamp is illuminated, but the illumination can be reduced to nil by varying the distance of the movable disc; when the desired position has been passed it reappears. In order to diminish error the mean a of these two distances is taken. If a layer of dielectric, of thickness d, be placed between the two stationary discs of the condensers, the movable disc must be displaced through a length, x, in order to make the light disappear. The following equations then hold, namely:—

$$a - x = a - d + \frac{d}{D} \qquad (1)$$

$$D = \frac{d}{d - x}. \qquad (2)$$

Stschegtiaeff examined the following substances, viz.: glass, benzole, water, ethyl-alcohol, methyl-alcohol. The liquids were placed in a glass trough with parallel sides. The results obtained showed full agreement with Maxwell's law, $\sqrt{D} = \eta \infty$.

Effects of Electrical Currents on Vegetable Life.

We have already had occasion to notice the almost sensational results which Spechnew, a well-known Russian agriculturist, has obtained in his researches upon the application of electricity to the culture of plants. He appears to be following out the same lines of investigation upon which the late Dr. Werner Siemens worked. His last results are almost of the same order as those we have previously noticed, but they are, perhaps, rather more suggestive. On submitting seeds to the

action of a weak electric current for two minutes before being planted, Spechnew found that they took about half the usual time required under ordinary circumstances for germination. He made ten trials with each of a large number of seeds, including peas, beans, wheat, rye, cucumbers, &c., and the results agreed in a remarkable manner; in every case the period of germination was reduced about 50 per cent. Samples of soil were also submitted to the action of a continuous current, and the effects of the current upon seeds planted in these samples were observed. These effects are reported as being simply prodigious. A radish grew to a length of 17·3 inches with a diameter of 5·5 inches; a carrot grew to 10·6 inches in diameter and weighed 6·6 lbs. Nor did this excessive size detract from the good quality of these vegetables, at least so say those enthusiastic persons who partook of them when cooked. Broadly speaking the crop was increased about fourfold for roots and from two to threefold for other plants. The current used in these experiments was supplied by the following simple apparatus :—two plates of zinc and copper 28 inches by 18 inches were sunk deep into the ground at the lower extremities of flat iron bars, the latter being joined through the air by means of iron wire.

Electric "Henergy."

If a hen and a half hatch an egg and a half in a day and a half, under common or garden conditions, how many hens will be hatched in half that time, by half the number of hens, using an electrically controlled incubator? This, and egg-puzzles generally, are now in a position to be answered to universal satisfaction, once and for all, by a series of experiments with a new incubator designed by Mr. Arthur M. Keays, A.I.E.E. To hatch chicks, without the aid of the "mudder berd," requires, together with eggs, a fairly steady temperature of 104° F. To attain this, Mr. Keays uses a mercurial thermostat, of thermometer form, to complete the circuit of an electro-magnet when the temperature gets too high. The electro-magnet is made to open a damper; cool air is thus allowed to enter the oven and bring its temperature to normal. According to the printed description we have received, this mercurial thermostat is claimed to be "of entirely novel construction," but it is a little difficult at first to understand how this can be. Of course, we still admit grave doubts as to the original order of sequence of hen and egg, with regard to "which came *first*;" but, judging from daily experience in "entirely novel constructions," we are almost forced to believe that the egg invented the hen, and yet mysteriously came *last*. So many inventors are born before their inventions! There is a very well known method of maintaining a constant temperature, used in connection with chemical ovens, in which the supply of gas is automatically regulated. Something of this kind would appear almost preferable, at least in point of price, to a device which needs a battery and electric control.

Electrical Variation of the Heart.

We are reminded by our New York namesake of recent researches on the "Electromotive Phenomena of the Mammalian Heart." The experiments of Bayliss and Starling and of Waller, are summarised in rather a sketchy manner, which renders it extremely difficult for the uninitiated to follow the investigation as it deserves. All electrical phenomena, connected with the mammalian heart, especially the human heart, are necessarily of interest. When Dr. Waller showed his beautiful experiments on this subject, a few years ago, public attention was much attracted thereto, and great hopes of a practical outcome were indulged in by many. For our own part, we have always felt that the difficulty of obtaining accurate observations on a living heart (especially when it is intact) is very great. The delicacy of the apparatus needed, the feeble nature of the E.M.Fs. set up, and the ease with which a difference of temperature, or other small cause, may upset the whole series of experiments, render the recorded observations far from conclusive at the present time. Even as the matter now stands, the authorities above quoted do not agree in one important point. Messrs. Bayliss and Starling found the base of the heart to be negative to the apex in the initial phase, while Waller found just the reverse. What the practical value of a correct knowledge on this point may be, time alone will show; but it is not difficult to foresee that any information upon electrical phenomena accompanying the action of so delicate and important an organ as the heart, may become of considerable value in the diagnosis of diseases of that organ.

Technical Instructors.

We gather from the remarks of an American contemporary that the salaries offered in that country for men engaged in electrical works, and men engaged in technical schools, occupy the inverse position to what they do here. Here the pay to men in electrical works is generally so very inadequate, that many prefer leaving that branch of the profession to go in for work in technical schools, where they can get a fair remuneration and have a chance of investigating. In America, on the contrary, it appears that the salaries in works are about double those offered to technical instructors, and consequently over a dozen vacancies exist in the various American institutions. One cause of the present low rate of pay in the profession is certainly the overwhelming number of young men, the sons of parents possessed of fair means, who enter as premium pupils. These are willing and able to take positions at a wholly inadequate rate of payment, and trust to their influence or luck to get a better one after a few years. In a case which came to our notice, an old pupil offered to take a not unimportant position for *nothing*, in order to be on the spot. When shall we be able to say that commercial work pays better for the subordinates than going in for technical teaching? At present this is rarely the case.

$C^2 R$.

It seems that some efficiency tests are about to be made upon electric heaters and cooking appliances. We are very glad to hear that such is to be the case. Not that we have any doubt about the powers of these modern inventions to warm a room or cook a chop, but because we can see in these tests the Nemesis of that tyrant, $C^2 R$. All along the line this mischievous little demon has been playing havoc with the efficiencies, and dissipating energy which the universe, and particularly our little corner of it, can ill afford to waste. Plenty of aspiring inventors have got into endless trouble through the interference of this tricksy Ariel, $C^2 R$. And now that *it* has been chained and set to do useful work, we shall all watch with interest to see how it will acquit itself. What will be the efficiency of the destroyer of efficiencies? But, alas! if $C^2 R$ is really the dissipation function of a circuit—and there does not appear to be room for doubt about it—there can be no other efficiency than 100 per cent. The heaters and cookers cannot fail to convert into heat all the energy supplied to them, and the commercial efficiency of the appliances will depend only on the skill which is exercised in directing this heat on to the chop or about the room. That practically the whole of the energy supplied can thus be usefully expended, we have but little doubt.

WATER POWER.

By E. TREMLETT CARTER.

(*Continued from page* 446.)

IX.

30. *Efficiency of Impulse Turbines.*—The theoretical or hydraulic efficiency of an impulse turbine is a simple function of the angle of entry of the water; but there are practical conditions which modify this and produce an efficiency very much below the theoretical value. If we assume that the whole of the energy due to the available head enters the engine as kinetic energy, which must occur in an impulse wheel designed according to the data given in the previous section, we have for the hydraulic efficiency

$$\eta = \frac{Q\,(v\,.\,\cos a)^2}{Q\,v^2} = \cos^2 a,$$

To obtain this, however, the velocity of the water over the vane must be reduced only by doing work on the vane, and not by any alteration of the stream section. If the area of the water path between the vanes at full gate is just sufficient to enable the water to move with the proper velocity at all points, then at partial gate there will either be a partial filling of the spaces between the vanes, or the velocity will be reduced to such a low value that the water still fills these spaces. The former will occur in turbines which are not drowned, and the latter when the tail water can get into the unused spaces and check the entering stream. Inasmuch as the shape of the vane is suited only to that velocity which is produced by full gate, a partial gate must result in a lowering of the efficiency, unless special precautions are taken to keep the engine free from flooding; and even in engines which are not working in dead water, a lower efficiency at partial gate will occur, on account of the contraction of the entering jet of water. On theoretical grounds, then, it must be expected that a turbine will not be as efficient at light loads as at the full load for which it was designed; and practical tests and experience bear out this conclusion. The drop in efficiency differs, however, with different types of engine; and there are turbines now in use in which the manner of supplying the water is so perfect that only a slight reduction takes place.

Consideration of hydraulic theory alone would lead one to make the angle of entry of the water very small; but practical considerations require that it shall not be reduced below a certain size. As this angle is reduced, so the velocity of flow through the turbine is reduced; that is so say, the water takes longer in passing from the entrance to the exit points. To pass a given quantity of water at a lower velocity of flow, will necessitate more roomy passages, and this, larger vanes and a heavier engine. Moreover, as the component of motion in the direction of the motion of the vane is increased, the curvature of the vane would require to be more sharp, leading the water over a greater amount of vane-surface, and thus increasing the loss of power on account of friction. All things considered, it does not pay to make the angle of entry less than 15 degrees in the largest engines, and the usual limits in practice are 20 to 35 degrees, with an average of about 30 degrees. The commercial efficiency of a good turbine constructed on these lines will be about 75 to 80 per cent. at full gate, running at exactly the right speed and under exactly the proper head; and the average efficiency between full and half load will not be less than 70 per cent.

31. *Partial Flow.*—The peripheral velocity of the vanes is determined by the head under which the turbine has to run, and will be higher for large heads than for small ones. the object of running the vanes faster under high heads is to avoid the inconveniently sharp curves which the vanes would require if run at low velocities. To increase the peripheral velocity does not, however, necessitate an increase in the number of revolutions per minute; for the diameter of the wheel can be increased proportionately. Two distinct advantages arise from having a larger diameter with a higher velocity; firstly, the centrifugal force on the water is prevented from rising to too high a value; secondly, the frictional losses at the bearings are not increased as much as they would be if the diameter remained constant. Now it might happen that with the increased diameter of engine the number of guide blades and vanes would be too large for the power required. Thus there might be required only 50 vanes to develop the necessary power, while the diameter might involve the fixing of as many as 200 vanes. To spread the working number over a larger diameter of wheel by putting them further apart would be bad practice, for it would be difficult to guide the water efficiently into vanes so far separated from one another. To distribute the water for 50 vanes among 200 would also be bad practice, for the losses on account of vane and guide friction would be increased without any corresponding gain in power. The proper solution of the difficulty lies in "partial flow," that is to say, in admitting the water into only a few of the vanes, leaving the greater part of the circumference of the wheel empty. In

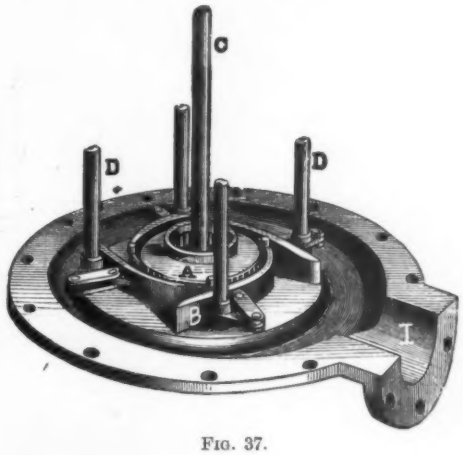


Fig. 37.

some turbines of this class only one-sixth of the circumference is supplied with water at full gate, and a smaller portion at partial gate; thus reducing the speed to one-sixth of what it would have been if the turbine had been designed for complete flow. Turbines of this class are used at the recently opened Tivoli electric light station. (See Electrical Review, July 15th, 1892.) It will, of course, be seen that partial flow can only efficiently be used where the idle tail water is not allowed to fill the vane spaces which are not being supplied with live water; and, therefore, can only be used in engines without suction pipes and free of the tail race.

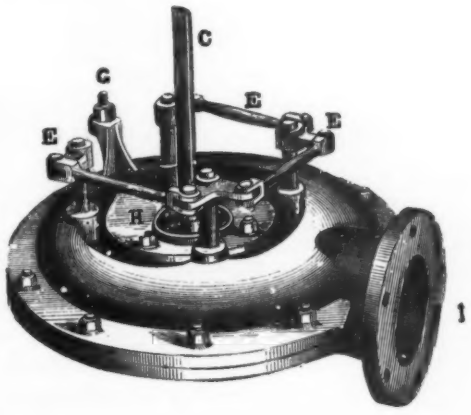


Fig. 38.

32. *Inward Flow Turbines.*—The special points in the various classes of turbines will now be discussed, chiefly by detailed reference to practical examples in use at the present time. The turbines which will be described will be those which are of modern and the most improved construction, every one of which is now doing electric lighting work on an extensive scale. The engines only will be described at present, the manner of setting them at the mill site being reserved for a later section. The "Vortex" turbine, the

invention of Prof. James Thomson, is the only practical example of inward flow turbines in use at the present time. This engine, originally invented in 1854, has undergone several modifications, chiefly with a view to its adaptation to the conditions of dynamo work. Fig. 37 shows the internal arrangements of the horizontal pattern with movable guides. Only the lower half of the flume and inlet pipe, I, is shown. There are four curved guide blades, B, conducting the water to the turbine wheel, A. Each of these guides is attached by means of a link to a vertical spindle, D, as well as being pivoted near its inner end. The four spindles, D, are connected together by means of a system of coupling rods (not

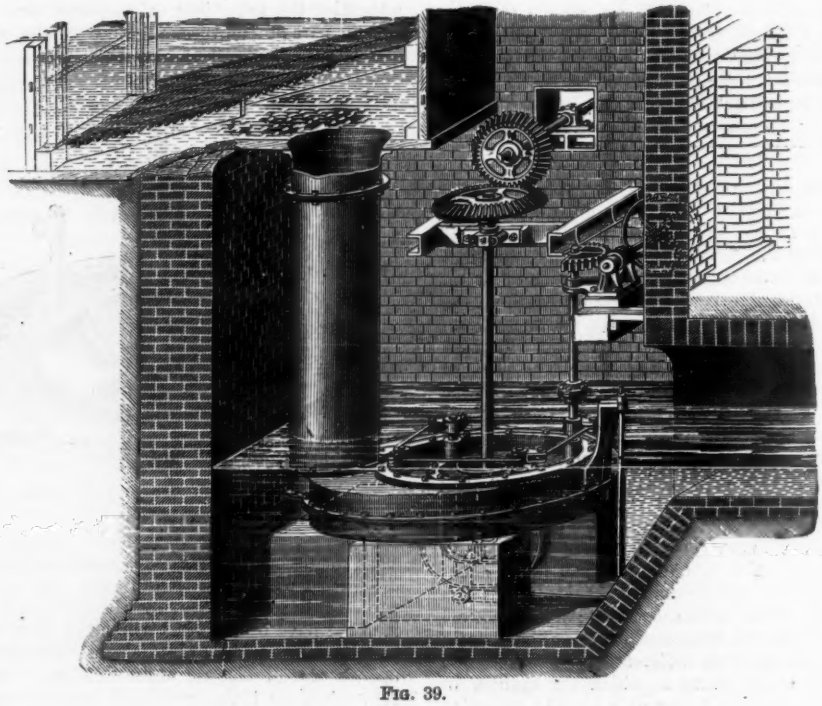


Fig. 39.

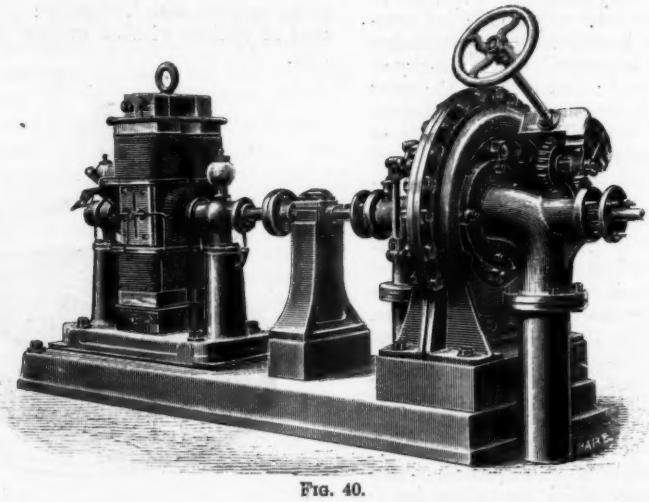


Fig. 40.

hown), so that when one moves the others are moved a similar amount. The vanes of the turbine are fixed in a cylindrical case or box, A, which is mounted on a step and fixed to the driving shaft, C. After passing through the vanes, the water reaches the innermost recess of the engine, and from this point is discharged equally upwards and downwards, a mode of discharge which gets rid of the reaction thrust on the step. Fig. 38 shows the engine with the upper cover in place, the coupling rods, E, having also been fixed to the rods, D. It will be seen that by moving the coupling rods in either direction the flow of water through the guide channels will be altered, for the guide blades will be turned round so as to bring their outer points nearer to, or further from, the sides of the adjacent blades. This very slightly alters the angle of entry, so that at partial gate the water will enter at a different angle, but the effect on the efficiency is not serious. The adjustment of the step is made by means of the bracket and screw, G. The vane spaces are designed to work efficiently with complete filling, so that the engine may be completely immersed in the tail water, as shown in fig. 39, or a suction pipe may be used and the shaft set to turn on a horizontal axis, as shown in fig. 40; the latter arrangement being, of course, the more convenient for electric lighting.

Fig. 40 is an illustration of a complete set of turbine and dynamo, as supplied by Messrs. Gilkes & Co. There are two suction pipes, the one balancing the other and preventing any end thrust on the bearings; and regulation is conveniently effected by means of the hand wheel, which actuates the guides. Vanes and guides for the smaller engines are made of rolled brass, and for the larger, of mild steel or wrought-iron plate; none of the working parts being cast enables the engine to be completely and cheaply adapted to each particular fall. This engine will work well on falls of 3 to 500 feet, giving an efficiency at full

gate of at least 75 per cent., and of about 70 per cent. at half gate.

In the "Vortex" or inward flow turbine, owing to the fact that the supply water is moving both towards the centre and round the centre, a centrifugal force is set up which causes a back pressure on the entering stream. The direct result of this back pressure is to reduce the velocity with which the water enters the wheel, substituting a head due to pressure for part of the head due to velocity. The engine is usually designed so that exactly half the available head at the point of entry shall be due to pressure on this account, the remaining half being due to kinetic energy. The advantage of this arrangement is two-fold. In the first place, only half the work being done by the direct impulse of the entering stream, and the velocity being lower than would otherwise be the case, there is less friction at the guides and over the vanes, and the work done on the vane is more evenly distributed over the entire path of the water. In the second place, the centrifugal back pressure tends to regulate the speed of the engine at varying loads; for if the load suddenly diminishes, the result is a tendency to race, which sets up a greater back pressure and limits to a small amount this tendency to increased speed; while if the load suddenly increases, the speed drops and the reduced back pressure permits a greater flow of water, so that more work can be done. This tendency to constant speed, while assisting the regulation of the engine, does not do away with the need of a separate governor, especially where, as in electrical work, the speed is to be kept within narrow limits of fluctuation.

33. *Outward Flow Turbines.*—The earliest turbines, such as those of Fourneyron, were of this type, and many of more modern construction are either purely or partially outward flow engines. These turbines are designed for both partial and complete filling of the vane spaces, as well as for partial and complete flow; so they sometimes are placed in the tail water and sometimes hang free. In every case, however, an outward flow turbine is placed at the lowest available point in the fall, suction pipes never having been used. While it would be possible to design such engines to work with suction, it would be necessary to make them very large and to run them very slowly, and would not be commercially good. The reason of this will be seen by reference to fig. 35 (par. 29), in which it will be seen that the path of the entering water is partly circular and partly radially outwards. There is set up a centrifugal force which acts on the water in the opposite manner to that in the "Vortex" turbine; for the water is assisted in its flow from the vanes, and a reduction of pressure at the point of entry occurs. A suction pipe would still further reduce the pressure and would be liable to break the entering stream into detached drops, the result of which would be a jerky motion in the engine. It will be remembered, then, that outward flow turbines can be used only at places where the engine can be conveniently placed at the bottom of the fall.

One of the best of the outward flow turbines is the partial Girard engine, to which reference has already been made. This wheel works with partial filling and partial flow, the degree of filling of the working vanes being the same for all loads, the number of working vanes being altered to suit the load. This engine is illustrated in fig. 41, which shows the vertical pattern with 48 vanes, six only of which are in use at any one time. These six working vanes are at the bottom of the wheel, and are supplied with water from six separate guide channels, each regulated by a separate sluice. The water passes vertically downwards to the tail race, having a clear fall of a few inches from the wheel. By turning the small wheel behind the stop-slide, one or more of the guide channels may be closed, the remainder working at full supply. Sometimes these channels are closed by means of a hydraulic ram, actuated by a centrifugal governor. A light metal casing covers the wheel when in use, but no pumps are required to keep this full of air, as it naturally remains so, being free of the level of the tail-water. Ventilation holes in the sides of the wheel admit air into the vane spaces during the time they are not in use. As the admission of water is wholly on one side of the wheel diameter, there is a considerable thrust on the bearings; but, as these work dry, they may be constructed of any of the usual metals, such as phosphor bronze or gun metal, and lubricated with oil. In the horizontal pattern of partial Girard turbine, this thrust on the brasses is obviated by placing one half of the guide channels on each end of a diameter, and by closing them in diametrically opposite pairs when the engine is to work at partial gate. This pattern is less convenient on account of the vertical shaft, bevel gear being required to enable it to drive an ordinary dynamo shaft; but on very low falls the horizontal pattern is the more economical of the two.

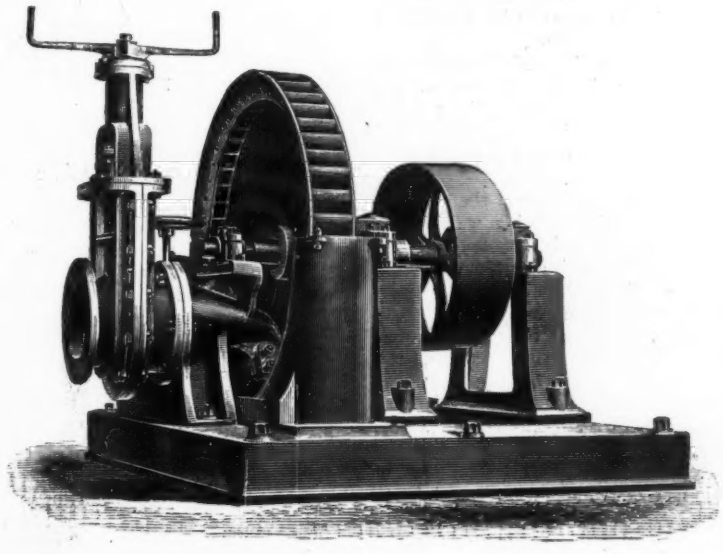


Fig. 41.

(To be continued.)

THE ACTION OF ALTERNATING CURRENTS ON THE HUMAN BODY.*

By W. KORTHALS.

We know that in New York criminals condemned to death are executed by electricity, and that an alternating current of a tension of about 1,700 volts is employed for this purpose. On the other hand, we learn the very curious fact that Tesla touched the poles of an induction coil of an electromotive

* *Elektrotechnische Zeitschrift.*

force of 70,000 volts without experiencing any ill effects. No explanation of the apparent contradiction in these two facts has been given up to the present. Although we know that the latter fact must be attributed to the excessive frequency, the true causes of the phenomenon are apparently undiscovered. The following considerations may, perhaps, throw some light on the subject.

The action of electricity on the human body depends, setting aside the different sensitiveness in different individuals, on the intensity of the current passing through the body. This is evidently the difference of potential existing between the two electrodes (and to which I shall refer in this article as the "body tension") divided by the sum of the resistance of the body and that presented by contact between the electrodes and the skin.

These two resistances are far from being constant. For

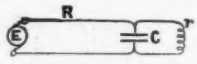


Fig. 1.

the sake of comparison, however, we may assume that the sum of the two resistances is constant, and that the intensity of the current is in proportion to the tension of the body. It is true that as far as sensitiveness is concerned, we should distinguish between continuous currents and alternating currents; but the danger of death is the same with both kinds of currents, and only depends on the tension.

We will examine the relations which exist between the tension to which the body is subjected and that of the source. In the case of the continuous current, the tension of the body is evidently equal to the difference of potential of the conductors which touch it, but with the alternating current the relation is more complicated.

In this latter case, we must take into account the capacity of the body, which need not be considered when we have to do with the continuous current. The body acts as a condenser, and the conditions under which it acts when brought into contact with a source of alternating currents may be represented as in fig. 1, where C is the capacity, r the resistance of the body, P the resistance of the outer circuit, and L its co-efficient of self-induction. In the first place the diagram indicates that the tension of the body is equivalent to the difference of potential at the terminals of the condenser of capacity, C; we will call E_c its maximum value. We have, therefore, to find the relation between E_c and the tension, E, of the source. Blakesley gives the solution of this problem by a graphic method, which we will use here.

This mode of representation is as follows (fig. 2):

$$C E = E_c ; \qquad (1)$$

$$\frac{C E}{E F} = \frac{r}{R} ; \qquad (2)$$

$$\tan \alpha = C \pi z \frac{R r}{R + r} ; \qquad (3)$$

z = the number of alternations per second;

$$\text{angle } C F O = 90^\circ ; \qquad (4)$$

$$\text{angle } E O P = 90^\circ \qquad (5)$$

$$\tan \beta = \frac{L \pi}{T R} ; \qquad (6)$$

T = the duration of a half-period;

$$C P = E. \qquad (7)$$

For the case in which there is no self-induction, *i.e.*, for $L = 0$ and $\beta = 0$, C O represents the tension E. We then obtain the following formulæ:—

$$E_c = C D \cos \alpha$$

$$C D = \frac{r}{R + r} E ;$$

$$\tan \alpha = C \pi z \frac{R r}{R + r}.$$

If the human body possessed no capacity, we should get $\alpha = 0$, $\cos \alpha = 1$ and $E_c = C D$; in this case C D represents the tension of the body.

E_c depends on two factors: C D and $\cos \alpha$, C D is determined by the value of R; we will call it the factor of the capacity as it only comes in if the body has any capacity. It diminishes when α increases, and α increases with R, and the frequency z.

These relations will enable us to explain why Tesla could touch with impunity the terminals of a bobbin giving 70,000 volts. The very high frequency employed ($z = 300{,}000$), together with the high resistance of the bobbin R = 9,000 ohms, give at the tangent and consequently at α so considerable a value that the factor $\cos \alpha$ becomes very small.

The value of E_c is therefore so small that the tension is harmless to the body. We do not know the value of C, but we can assume a certain value for E_c, deduce from that the value of C, and test whether the latter really gives for a smaller number of alternations a sufficient tension to cause death. We will assume then that the tension Tesla had to bear was at the maximum $E_c = 100$ volts. The other values that we must use are the following:—

The induction coil had a resistance R = 9,000 ohms, and gave a mean tension of 70,000 volts, and therefore

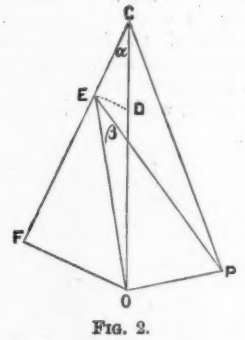


Fig. 2.

a maximum tension of E = 100,000 volts. The *Electrical World* gives as the resistance of the body, $r = 1{,}050$ to 3,500 ohms; as the value of r does not affect the result for which we are searching, we will assume that $r = 1{,}000$ ohms. The frequency was $z = 300{,}000$ to 400,000. We had no datum as to L, but this factor would have the most unfavourable influence in that part of our calculation where the ratio of E_c to E was very great, for it would then be necessary, in order to obtain the same tension, E_c, to take a much greater capacity. Thus, if the second part of our calculation furnishes, with a high value for C, a result in accordance with the experiment, this result would be still more easily attained with a low value for C. The greatest value for C corresponds to the case in which the angle, C P O, is 90°. In this case C P and C O are very little different from one another, and we have L = 0, so that we may take out the self-induction. The calculations to be established are as follows:—

$$E_c = C D \cos \alpha$$

$$C D = \frac{r}{R + r} E,$$

$$\tan \alpha = C \pi z \frac{R r}{R + r},$$

thus
$$C D = \frac{1{,}000}{10{,}000} E = \frac{1}{10} E = \frac{1}{10} 10^5.$$

Moreover,
$$100 = \frac{1}{10} 10^5 \cos \alpha$$

$$\cos \alpha = \cdot 01$$

$$\alpha = 89 \cdot 25^\circ$$

$$\tan \alpha = \infty \; 100,$$

whence
$$C n z = \frac{9{,}000 \times 1{,}000}{9{,}000 + 1{,}000} = 100$$

$$C \pi z = \frac{1}{9}$$

$$C z = \cdot 0353$$

and
$$z = 300{,}000$$

$$C = \cdot 118 \text{ of a microfarad.}$$

Thus a capacity of ·118 of a microfarad is sufficient to lower the tension of the body to 100 volts, notwithstanding

the enormous tension of the bobbin. This value of the capacity will merely serve to establish comparisons.

Let us again inquire what influence is exercised by r on the value of C. If r were greater than 1,000 ohms, C D would be greater, cos a smaller, and a still greater than 89·25°; but for these values of a we can assume that sin $a = 1$, and

$$\tan a = \frac{1}{\cos a}.$$

On making this substitution, we get

$$C \pi z = \frac{R r}{R + r} = \tan a = \frac{1}{\cos a} = \frac{C D}{E_c},$$

$$= \frac{r}{R + r} \quad \frac{E}{E_c}$$

or

$$C \pi z R = \frac{E}{E_c}$$

$$C z = \frac{1}{\pi} \quad \frac{1}{R} \quad \frac{E}{E_c}$$

For this value of a, therefore, C is independent of r. This is not the case in the second part of our calculations upon which we are now going to enter. Let us take the ordinary frequency, $z = 100$, and find E_c. For $r = 1{,}000$ we get:

$$\tan a = \cdot 110 \times 10^{-6} \pi 100 \frac{9{,}000 \times 1{,}000}{10{,}000} = \cdot 0333$$

$$a = 1° 54' \qquad \cos a = \cdot 9994$$

$$E_c = \frac{1}{10} 10^5 \cdot 9994$$

$$E_c = 9{,}994 \text{ volts.}$$

Thus, with this number of alternations per second we obtain a tension of the body which is excessively high, and very little different from what it would be without capacity; for we should get in our particular case, without capacity:

$$C D = \frac{r}{R + r} E = \frac{1{,}000}{10{,}000} E = 10{,}000 \text{ volts.}$$

This result would be changed if we were to consider r greater; but we should get E still more considerable.

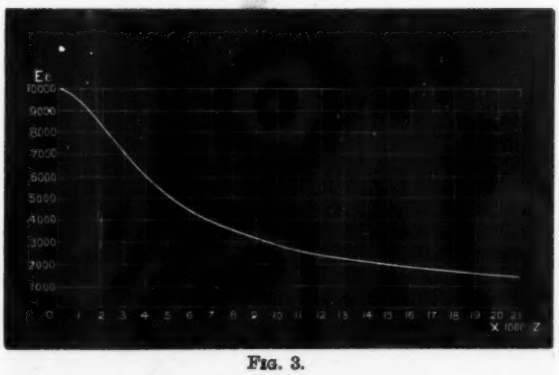


Fig. 3.

We have thus shown that, considering the human body as a condenser, the calculation relating to the action exercised by alternating currents gives results in accordance with those obtained by experiment. The approximate value found for C enables us to study the influence of R and z on the factor cos a. We will write

$$\tan a = C \pi z \frac{r}{1 + \frac{r}{R}}.$$

For very small values of R we may disregard the 1 before $\frac{r}{R}$, hence

$$\tan a = C \pi z R$$

For instance, for R = ·01 ohm and $\frac{r}{R} = 10{,}000$

$$\tan a = \cdot 118 \times 10^{-6} \pi z \cdot 1 = \cdot 0371 \times 10^{-6} z$$

and for $z = 10^6$

$$\tan a = \cdot 0371:$$

therefore

$$a = 2° 10'$$

$$\cos a = \cdot 9993.$$

This result shows that for low values of R the angle a approximates to zero, and only takes an appreciable value if we greatly exceed the frequency employed by Tesla. Thus the influence of the capacity of the human body disappears in this case and we get $E_c = E$. It can, therefore, be understood that by employing the usual frequencies the contact of the body with the terminals of a machine having a low internal resistance would be fatal.

In Tesla's experiment R was greater, and the following table may give an idea of the influence that R and z then exercise on the factor, cos a, and consequently on the tension of the body:

R = 100	9,000	100	0000
z = 100	100	300,000	300,000
tan a = ·00337	·0333	10.1	100
a = 12′	1°54′	84°20′	89°25′
cos a = 1	·9904	·0987	·01
$C D = \frac{10}{11} E = 90{,}909$	$\frac{1}{10} E = 10^4$	$\frac{10}{11} E = 90{,}909$	$\frac{1}{10} E = 10^4$
E_c = 90,909	9,994	8,976	100

We see that Tesla had combined all the conditions that would enable him to render contact with the electrodes of 100,000 volts difference of potential.

It is interesting to follow on a curve the variation in tension that the body undergoes as a function of the number of alternations per second.

The curve in fig. 3 has been calculated by taking as a base the numbers we have just used, and we see that as soon as the ordinary frequencies are exceeded, the difference of potential rapidly diminishes and finally tends to an asymptote, which is no other than the axis of the abscissæ.

A STUDY OF THE INFLUENCE MACHINE.

By J. E. TAYLOR.

(Continued from page 431.)

One of the simplest forms of influence machine is the ordinary electrophorus. It is an example of the principle of sub-division of lines of strain, and a clear grasp of its action will be very helpful. In diagrams 14, 15, and 16, S is the

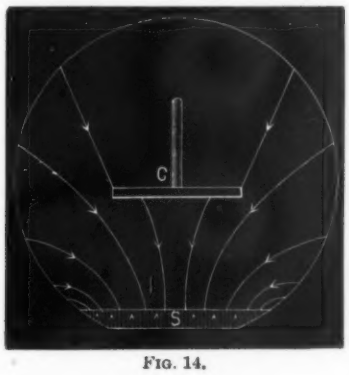


Fig. 14.

sole, and C the cover, the outer ring representing as usual the effect of earth-connected surfaces, such as the walls and ceiling of a room and other conducting objects. Fig. 14 simply represents the feeble induction which the insulated cover, C, undergoes when brought into the field of the electrified sole, S. On placing the cover on the electrified sole and making the earth connection to former (fig. 15), the first effect is to neutralise a great many of the lines forming the electrification of the sole, that is, to partially discharge it almost as a Leyden jar is discharged on connecting the two coatings, thus putting the two ends of each line in direct connection. Since, however, the cover only touches the sole in three or four points, the discharge is very incomplete and a great number of very short lines of strain remain in the air film between the cover and the sole, as shown. A piece of thin flexible tin foil or gold leaf spread out and brought into intimate contact with the surface of the sole, will discharge it much more completely, but even then we cannot get entirely rid of the insulating air film. There is every

reason to suppose that the charge resides only on the surface (that is, that the ends of the lines are on the surface) of the sole, and that it does not penetrate below as is generally assumed, for the lines are just as liable to die out and thus terminate at any point in the interior of the sole, as immediately below the surface, and this we know does not

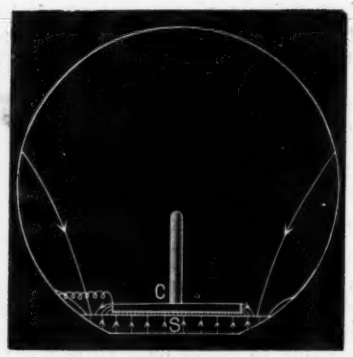


FIG. 15.

happen to any great extent. On withdrawing the cover again two actions take place among the lines simultaneously these are, first, the total energy of strain existing is very greatly increased by forcibly elongating the lines, also these lines, as the cover recedes, find a short cut through the earth and thence back again to the surface of the sole upwards through its substance. This latter action amounts to using the earth as an auxiliary conductor wherewith to divide the lines of strain between the cover and sole. Those portions of the lines now existing between the earth and cover constitute the available energy of strain, whereas their continuations existing between the surface of the sole and the earth are kept as the agency by which more energy can be developed. The electrophorus thus never increases the number of lines originally existing but merely lengthens them.

Many forms of influence machines are merely rotary electrophori; such are those of Bertsch, Carré, and others.

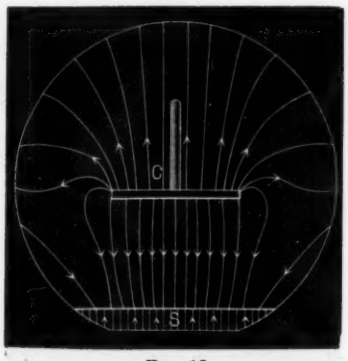


FIG. 16.

The best machines, however, involve both the principles of sub-division of lines and superposition of fields. The Holtz machine, with one fixed and one revolutionary plate, is a good elementary example (fig. 17). The electrostatic fields emanating from the charged surfaces of the glass which are approaching either field plate are superposed on those of the field plates, which thus have their charges replenished, the discharging effect of the paper tongues severing the lines connecting these surfaces with the field plates, this being practically equivalent to a contact between the two. The strain existing between the knobs when separated is part of that existing between the positive and negative field plates. It is severed from either plate, however, by the discharging effect of the combs, and thus a continuous supply of strain may be drawn from the field existing between these inductors or field plates by the aid of the auxiliary conductor composed of the rods and combs.

In all machines developing positive and negative charges, the lines of strain extend from the positive to the negative side of the machine, the earth merely forming an intermediate conductor through which they can partially short circuit themselves.

Lord Kelvin's replenisher involves identically the same principles of action as the Holtz machine; but he uses the charges on the field plates, leaving the neutralising rod (the equivalent of the rods and combs in Holtz's machine) intact.

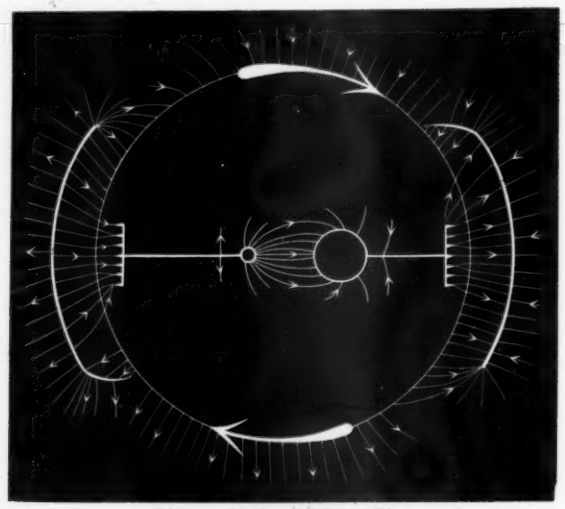


Diagram of action of Holtz machine.

FIG. 17.

Other machines involving the same principles are :—Nicholson's doubler, Bellis's doubler, Varley's machine, and the remainder of Lord Kelvin's machines.

It is evident from the design of the above form of Holtz machine, that its action will be more energetic when employed for generating much lower potential differences between the electrodes than the maximum it is capable of maintaining, for the nearer the discharging knobs are together, the greater the average difference of potential between the combs and the field-plates, and consequently the denser the charges on the glass surface of the revolving plate. The rate of generation of strain or severing of the lines at the combs is thus a function of the distance apart of the discharging knobs,

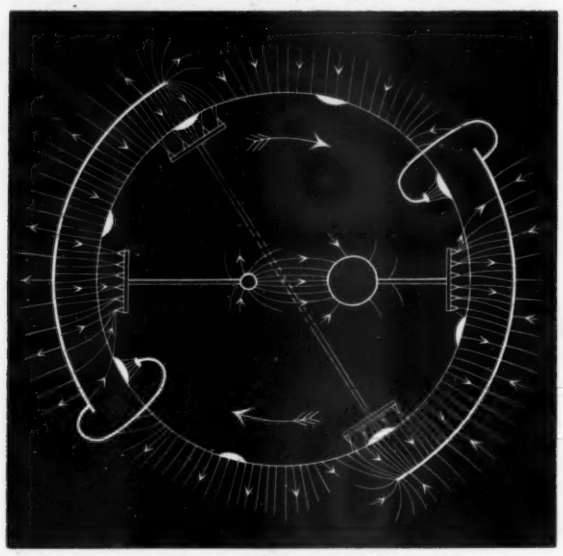


Diagram of action of Voss machine.

FIG. 18.

being greater when they are near and less when they are far apart. Indeed, the action of the machine will die out altogether when the knobs are separated beyond the striking distance for some time, owing to the feebleness of the action not being able to keep pace with the rate of leakage from the field-plates. The addition of a neutralising rod placed so that it may follow and complete the work of the combs (see Voss machine, fig. 18), does away with these disadvant-

ages. It may be mentioned that the reverse of the above holds true for those machines wherein the charges of the field-plates are utilised; that is, they work better on open circuit, for then the difference of potentials between the field-plates is greatest.

The principal differences which constitute the Voss, an improvement on the Holtz machine, are: first, the provision of a neutralising rod; second, metallic sectors or small discs are provided, which make machine self-exciting when clean; thirdly, the absence of windows in the stationary plate. Fig. 18 gives a diagram of its action, and from what has been said of the Holtz, it will be easily followed. The most interesting of the older forms of the Holtz machine is the second type, with plates revolving in opposite directions. It was by no means the most efficient form, but was a very near approach in design to the best of modern influence machines, namely, the Wimshurst. By making both plates to revolve in opposite directions, Wimshurst obtained the equivalent of doubling the speed of rotation of the stationary plate form. The connections of the machine are shown in fig. 19; the action will be seen from the Wimshurst diagram,

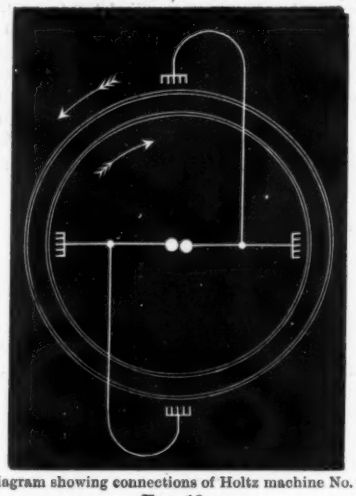


Diagram showing connections of Holtz machine No. 2.

Fig. 19.

fig. 20. It was necessary, as in the other form of the Holtz machine to put the knobs in connection when starting the same. A connection may be established between this and the first machine if we regard the field-plates merely as an assistance to the induction already taking place on the revolving plate. For consider the machine as in full work and the field-plates suddenly taken away out of range of induction. The action will still go on for a very short space of time, owing to the induction of the charges approaching either comb upon the comb and glass surface immediately below. But the quantity of induced charge is less than the inducing charges, and so the action rapidly dies out. But suppose instead of allowing the charges to travel idly round the plate, we cause them to assist the identically similar action taking place on a neighbouring plate and combs rotating oppositely (as, otherwise, their mutual reaction on one another would oppose instead of assisting the action); each plate will assist the induction on the other so much as to produce a rapid increase or tendency to increase their charges. This is the arrangement shown in fig. 19, the similar combs on each plate being connected together, so as to combine the action of both neutralising rods at the discharging knobs when separated.

The Wimshurst Machine.—It may not be generally known that the active principle of the Wimshurst is identical with that of Holtz's second form of machine. In fact, a Wimshurst, with the collectors removed, is identical with the Holtz on closed circuit, excepting, of course, in that the former is usually (but not necessarily) provided with metallic carriers. Had Holtz only taken his charges or supplies of strain from the right parts of his machine, the Wimshurst would have been invented 25 years ago. He was, it may be mentioned, fully aware of the advantages possessed by metallic carriers in the matter of self-excitement. The *modus operandi* of the Wimshurst is that which has just been explained with respect to Holtz's second form; but it is worth while to point out that the factor which is liable to be lost sight of in its action, and without which, as will be shown presently, all explanations are erratic, is the induction which the neighbouring approaching charges on the same disc exert on the neutralising brushes and surfaces of the plates or carriers immediately below them. The increase of charges is represented, as well as can be done consistently with clearness, in fig. 20, in which the collectors are not shown, as they are

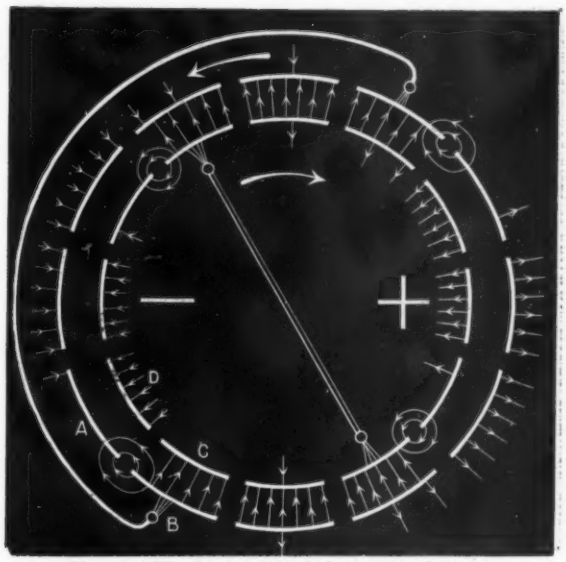
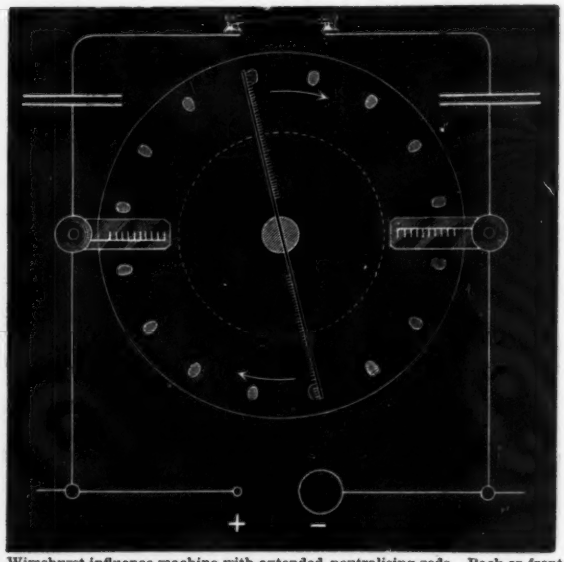


Diagram of Wimshurst machine during increase of charges.

Fig. 20.

quite supplementary. Taking one line of strain as representing one unit of charge, each successive carrier as it is supposed to have passed the neutralising brush has one more unit induced on it than the previous one had. If we suppose the carriers having the maximum number of lines to have their charges represented by a much greater number and each previous carrier to have one line or unit less, then the diagram will convey a more correct representation of the true state of affairs. The increase can, however, be much better shown by taking the small numbers given in the diagram. The induction of the neighbouring carriers on one another on the same plate is indicated between those passing under the neutralising brushes and those approaching them. Thus carrier A is acting on B, which is also acted on to a greater extent by C, and to some extent, probably, by D. But C and D of themselves are unable to act sufficiently to produce an increase on the successive carriers and it is only on the superposition of the field emanating from A on that of D, that a sufficiently strong field is produced at this part to cause the induction to rise. That this is so may be proved by providing the collectors of an ordinary Wimshurst with brushes making connection with the carriers as they pass and putting the knobs in contact, when the action is at once annulled, owing to those sectors represented by A being completely discharged. It will thus be seen that a Wimshurst ought to work best on open circuit, as then such sectors have the maximum charge remaining on them. That is, it should be classed with those machines like Lord Kelvin's replenisher which work more energetically when the discharging knobs are far apart, and which work but slowly when joined up to Leyden jars of large capacity, these of course tending to keep the difference of potentials low. This is in accordance with practice, for a Wimshurst will sometimes prove tedious for charging large batteries, even failing in damp weather. It should be remembered, however, that this effect is not so prominent as it might be if the leakage factor remained constant for all potential differences, which is far from being the case. The reason why combs are used on the collectors is to allow the action to start before the points of the combs commence to discharge, which they do not do until a fairly high potential is reached. The result of this is that the Wimshurst machine will remain in action whilst the knobs are put together. Another factor tending to keep up the action under these circumstances is that the points do not discharge the sectors by any means instantaneously, and thus their speed of rotation round the discs will protect their charges. Seeing this, it may be asked whether it would not be advisable

to use light conducting flaps attached suitably to the conductors in place of the points or combs. Accordingly flaps of flexible oiled silk attached to glass supports and edged with gold leaf, or other conducting material, which are normally kept off the surfaces of the discs by their own weight or elasticity, have been tried as depicted in fig. 21. When



Wimshurst influence machine with extended neutralising rods. Back or front view of plates, Connections diagrammatic.

FIG. 21.

the machine comes into action they are attracted up against the discs and appear to be an improvement on the combs. They are also provided on the neutralising rods in addition to the metallic brushes, and are in this case normally against the surface of the glass.

The machine in fig. 21 carries its charges mainly on the glass surfaces, the metal carriers being added as in the Voss machine merely for purposes of excitement. A machine so arranged is for many purposes superior to the usual form. It is perhaps not so readily self-exciting except when perfectly clean, and is rather more susceptible to atmospheric influences, but the surface leakage is much decreased, a much larger quantity of charge is evolved in a given time, and a higher potential difference can be developed. A very great improvement is secured for working on short circuit or charging jars by extending the flaps on the neutralising rods inwardly, so as to bring into action that part of the surface of the plates which is never discharged by the collectors. This arrangement renders it many times more efficient when used for low potential differences. The dotted ring in the figure shows the undischarged portion of the plates. A machine constructed as above with 18-inch diameter glass plates will give a spark between the knobs when separated by a distance of 7½ inches.

A CORRECTION.—In fig. 13 in the previous article, through some error, the transverse lines of strain from surface to surface inside the glass have not been shown. These should have indicated a field inside the glass many times as dense as that shown in the air portion; in other words the lines which in the drawing look like section lines, should have gone horizontally across from surface to surface.

(To be concluded.)

TELEGRAPHS IN BRITISH GUIANA

[FROM A CORRESPONDENT.]

BRITISH GUIANA has recently had three new cables added to the number previously in use, one of which is of special interest on account of its being laid in the bed of the River Essequebo for over 30 miles, no road existing for that distance, in fact, the water-ways, being the highways of travel, have now begun to be the cable ways also.

For many years it had been thought desirable to have telegraphic communication between the Penal Settlement at the mouth of the River Massaruni—a tributary of the Essequebo—and Georgetown, the seat of Government; and about ten years ago, $30,000 was actually voted, and several miles of cable ordered and imported. The matter, however, at the time went no further, but recently, the growing importance of the town of Bartica, as a centre for the gold industry, led to the Goverment appointing a commission to report upon the practicability of one of three schemes suggested. Mr. Vyle, the Government electrician, and the assistant Crown surveyor were nominated for the work, and after a ten days' survey of the right bank of the River Essequebo, reported against any land line being erected on account of the dense bush, or jungle, and recommended the novel plan of laying a cable in the bed of the river for the distance where no road existed. A specially light cable, under one ton per knot, was manufactured by the Silvertown Company, and a two wire cable for a telephonic line from Bartica on to the Penal Settlement. Both these cables duly arrived in Demerara in June last, and were carefully laid under the superintendence of Mr. Vyle. He was aided in the work by Mr. Gilbert C. Vyle, assistant electrician, and Mr. J. Marshall, line foreman, the paying out hands being all black labourers, usually employed on telegraph works. A land line of No. 14 copper wire had been run in readiness for the cables, so that when a mile of cable was laid about a mile above Georgetown across the Demerara river, communication was established with the Hooboo Creek on the Essequebo, nearly forty miles distant, and, finding the signals so good when connected to the cable, messages were exchanged with Georgetown the whole time the cable was being paid out—an operation done against the stream, during thirty-three hours' steaming. The circuit is a direct one, and fitted with the first double current Morse set used in the colony; it is also fitted for duplex working if necessary.

The telephone circuit from Bartica to the Penal Settlement, works well through the twin wire cable, thus saving clerical labor, which Morse working involves.

In preparing for the additional 200 wires for the new switchboard, Mr. Vyle thought it advisable to concentrate all wires on to one terminal, and accordingly erected a cupola on 50 feet poles, capable of receiving in all 1,200 wires.

In addition, the town of New Amsterdam, some 70 miles from Georgetown, has been fitted with a 50-wire exchange; and now the subscribers are asking for direct communication with Georgetown.

Last year the greater part of the telegraph lines were renewed, copper wire taking the place of dry-jointed No. 8 iron, and double-white insulators superseding old iron-clad ones, to the great improvement of working. Two creeks, where cables were frequently damaged, have been crossed with open wires, high enough to allow sail punts to pass below, by splicing a 40-feet greenheart to a 50-feet one. These poles were fitted in Georgetown, and sent to the points required, spliced and erected in July last. By the end of the present financial year, the whole of the lines of British Guiana will have been renewed, and every bit of iron wire for telephones and telegraphs will have been replaced by copper.

Mr. Vyle is now in England on a long furlough, after his five years' work in a tropical climate, his son, Mr. G. C. Vyle, acting in his absence.

A NEW LUBRICATOR.*

LUBRICATION is an essential point in the good working of a dynamo. We want to know how to introduce a sufficient quantity of oil at the right moment, so as to prevent the bearings from becoming heated, and also to prevent the oil from being used wastefully and when not required.

There are many apparatus capable of effecting this distribution regularly. We may mention, in the first place, the ring lubricators, which consist of a metal ring mounted on the axle and partly immersed in the oil. The axle, when turning, carries the ring with it, and the latter brings with it a certain quantity of oil which is spilt on the axle. To all these lubricators there is the objection that the oil is scattered in all directions by the centrifugal force, and is consequently very often sprinkled anywhere but on the axle to be greased. Thus, in the first place there is great waste of oil, and secondly the framework of the bearings is

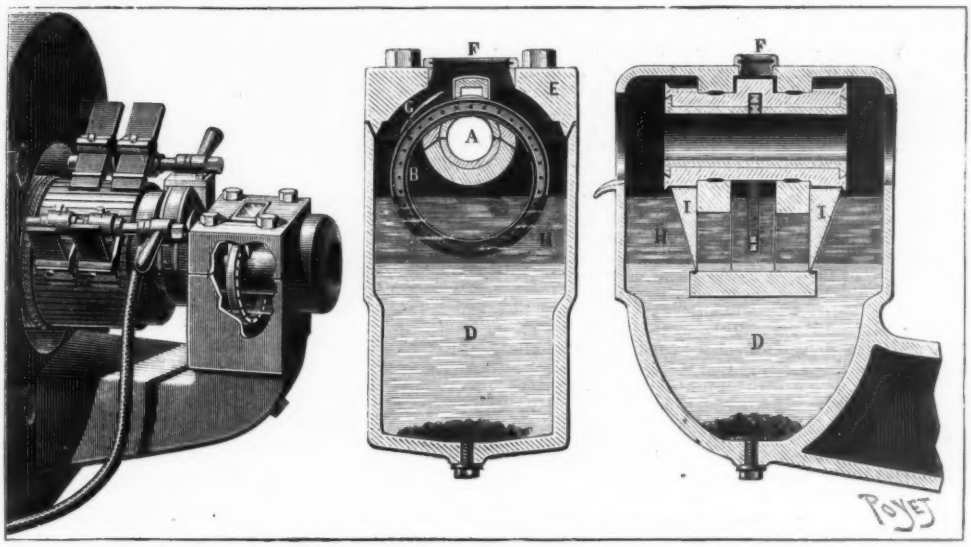
* *La Nature.*

always in bad condition. Several other systems have, however, been proposed. We may mention, amongst others, the drop-counting lubricators, and the distributions of oil for central electrical stations, installed in Paris in the Palais-Royal Works, the Avenue-Trudaine Works, the Rue de Bondy Works, &c. A reservoir of the required capacity is placed at a certain height and sends oil into copper pipes, which convey it to the bearings of the dynamos. The waste oil is then collected into a receiver, filtered and conveyed back to the reservoir.

This system, which is very effective and very economical, is only suited to installations of some importance. Therefore, M. F. Henrion, of Nancy, the well known maker of electrical machines conceived the idea of adapting an arrangement of this kind to be attached to the bearing of a dynamo.

This new lubricator consists essentially of a ring, B, made of copper with a rectangular section mounted on the axle, A (see fig.) This ring turns in a small quantity of oil, H, floating on a layer of water, D.

As the figure shows, the ring, B, turns in the centre in the middle of the filtered oil. In fact, on the sides are little inclined filters, I, I; the oil cannot reach the centre without passing through these filters, and the impurities which do not adhere to the filters fall to the bottom of the vessel.



The ring turning carries with it the oil, which is conveyed mainly by the little openings in the circumference. The oil reaches the upper part, G, as shown in the fig., and is then distributed by means of little channels arranged for the purpose. The important point is, there is always sufficient oil to ensure lubrication. We had occasion recently, writes M. Laffargue in *La Nature*, to examine some machines at work that were provided with this lubricator. We found no signs of over-heating. We observed at G a certain quantity of oil, which as it accumulated retarded the movement of the ring, and gradually spread over the axle; the movement was then resumed. The upper part of the pedestal enclosing the lubricator is covered with a sheath kept in place by means of bolts, E; in the centre is a little opening fitted with a glass, F, through which the working of the apparatus can be seen. On the side is the overflow pipe, and at the bottom the waste plug.

In short, Fabius Henrion's lubricator contains new and practical improvements, capable of effecting a considerable saving in the expenditure of oil, which is often very great.

Electric Lighting at Preston.—Owing to the extended support given to the Preston Electric Lighting Company, the directors find themselves in a position to reduce the price per unit from 8d. to 7d., which, with an allowance of 15 per cent. for prompt payment, makes the cost equivalent to 6d. per unit.

ON THE CHANGES PRODUCED BY MAGNETISATION IN THE LENGTH OF IRON AND OTHER WIRES CARRYING CURRENTS.*

By SHELFORD BIDWELL, M.A., LL.B., F.R.S.

The changes of length attending the magnetisation of rods or wires of iron and other magnetic metals which were first noticed by Joule† in 1841, and have in recent years formed the subject of many experiments by myself,‡ have been found to be related to several other phenomena of magnetism. Maxwell§ has suggested that they sufficiently account for the twist which is produced in an iron wire when magnetised circularly and longitudinally at the same time. The resultant lines of magnetisation, as he points out, take a spiral form; the iron expands in the direction of the lines of magnetisation, and thus the wire becomes twisted. Prof. G. Wiedemann, however, to whom the discovery of the magnetic twist is due, appears not to be satisfied with this explanation‖, believing the effect to be caused by unequal molecular friction.

The subject of magnetic twists has been very fully and carefully investigated by Prof. C. G. Knott, and in a paper published last year in the *Transactions of the Royal Society of Edinburgh* (Vol. 36, part II., p. 485) he indicates many details in which the phenomena of twist closely correspond with those of elongation and retraction. Assuming their essential identity, and noting that "an increased current along the wire affects the points of vanishing twist in a manner opposite to that in which an increased tension affects it," Prof. Knott is "inclined to conclude that the pure strain effects of these influences are of an opposite character." Now, since the magnetic elongation of an iron wire is known to be diminished by tension, the remark above quoted amounts to a prediction that in an iron wire carrying a current the magnetic elongation would be increased. "We know nothing so far," Prof. Knott observes, "regarding the changes of length when an iron wire *carrying a current* is subjected to longitudinal magnetising forces," and it was with the object of acquiring some information on this point and testing Prof. Knott's prediction that the experiments described in the present paper were undertaken. The results show that it was amply verified, and thus Maxwell's explanation of the twist receives still further corroboration.

The apparatus used and the methods of observation were the same as those described in my former papers. Each specimen of wire examined was 10 cm. long between the supporting clamps, and the magnetising coil, weighing nearly 3 lbs., was as usual supported by the wire itself, an arrangement which, for reasons before given, was essential. The indications of the instrument were read to one ten-millionth part of the length of the wire, and the wire was demagnetised by reversals before each single observation.

Experiment 1.—The wire first used was of soft commercial annealed iron, 0·75 mm. in diameter. The changes of length which it exhibited under the influence of magnetising forces gradually increased from 13 to 315 C.G.S. units, are indicated in the second column of Table I., in which the unit is one-millionth of a centimetre or one ten-millionth of the effective length of the wire. The magnetising forces given in the first column are those due to the coil only, no account being taken of the demagnetising effect of the wire. The results are also plotted

* Read May 19th before the Royal Society.

† "Joule's Scientific Papers" (Phy. Soc.), pp. 48, 235.

‡ *Phil. Trans.*, Vol. 179, A., p. 205; *Roy. Soc. Pro.*, No. 237 (1885), p. 265; No. 242 (1886), p. 109; No. 243 (1886), p. 257; Vol. 43, p. 406; Vol. 47, p. 469.

§ "Electricity and Magnetism," Vol. 2, Sec. 448.

‖ *Phil. Mag.*, July, 1886, p. 50.

as a curve in fig. 1. It will be seen that the maximum increment of length, attained in a field of about 40, was 11·5 ten-millionths; the decrement of length in a field of 315 was 22·5, while the original length of the wire was unchanged in a field of 130.

TABLE I.—IRON WIRE, diameter 0·75 mm.

Magnetic field due to coil. C.G.S. units.	Elongations in ten-millionths of length.		
	With no current through wire.	With 1 ampère through wire.	With 2 ampères through wire.
13	3	7	...
16	6	9	11·5
23	7·5	12	...
34	10	14·5	20
40	11·5	14	...
50	10	14	20
61	9·5	12	...
81	6	9·5	16
97	4	8	...
130	0	3·5	8
171	− 4	0	...
202	− 9	− 4	− 1
244	− 13·5	...	...
250	...	− 9	− 5
315	− 22·5	...	...
319	...	− 18·5	...
323	...	...	− 13

Experiment 2.—A current of 1 ampère was then passed through the wire. The current, which was derived from a Grove's cell, was measured by a tangent galvanometer and regulated by a rheostat, which had been approximately adjusted on the previous day. As soon as the circuit was closed, the index of the measuring instrument began to move, rapidly at first and afterwards more slowly, in the direction indicating elongation of the iron wire. In about two minutes the index had come to rest again, the number of scale divisions over which it had passed showing that the original length of the wire had increased by 310 ten-millionths. Assuming the coefficient of expansion of the iron to be 122 ten-millionths per degree Centigrade this elongation denoted a rise of temperature (due to current heating) of about 2·5°. The experiment described in the last paragraph was then repeated, the several magnetising forces employed being made as nearly as possible the same as before by inserting the same resistances successively in the circuit.* The results appear in the third column of Table I., and in the middle curve of fig. 1. The latter shows clearly that the maximum elongation had risen from 11·5 to 14·5 ten-millionths, while the decrement in a field of 315 had fallen from 22·5 to about 17·5.

Experiment 3.—The current through the iron wire was then increased, by an alteration of the rheostat, to 2 ampères. The further elongation of the wire due to the heating effect of the increased current was very nearly 1,000 ten-millionths, corresponding to a rise of temperature of 8·2° C. This added to 2·5, the rise due to the current of 1 ampère, which was passing before, gives 10·7° as the excess of the temperature of the wire carrying 2 ampères above that of the room. When the index had become steady, which happened in the course of about 2½ minutes, another series of observations was made; but instead of applying all the previously employed magnetising forces in succession, alternate ones were omitted. This was done for the purpose of shortening the experiment, it being thought doubtful whether the Grove's cell which supplied current to the iron wire would remain sufficiently constant when giving so strong a current as 2 ampères. The results of the experiment are contained in the last column of Table I., and in the highest of the curves in fig. 1. There is again a marked increase of the maximum elongation, and decrease of the retraction in a field of 315.

For the sake of easy comparison, the principal results obtained with this wire are collected in Table II.

TABLE II.—IRON WIRE, diameter 0·75 mm.

Current through iron wire. Ampères.	Maximum elongation in ten-millionths of length.	Retraction in field of 315 C.G.S. units.	Field in which length is unchanged.
0	11·5	25·5	130
1	14·5	17·5	170
2	20	12	200

Experiment 4.—The previous observations were repeated with another specimen of soft iron wire of greater diameter, viz.: 1·05 mm., no current being at first passed through it. The results appear in the second column of Table III. and in fig. 2.

TABLE III.—IRON WIRE, diameter 1·05 mm.

Magnetic field due to coil. C.G.S. units.	Elongation in ten-millionths of length.	
	With no current through wire.	With 2 ampères through wire.
7	1	2·5
16	6·5	11
25	...	15
34	13	18
40	14	18
50	12·5	18·5
62	12	18
87	10	16
134	3·5	8
213	− 5·5	− 1
263	− 10·5	− 8
338	− 20	−16·5

Experiment 5.—A current of 2 ampères was passed through the same wire, resulting in an elongation due to heating of 460 ten-millionths, the temperature of the wire being therefore raised about 3·3°. The former observations were again made with the results given in the last column of Table III. and in fig. 2.

It will be seen that with both specimens of iron wire, the effect of a current is of just the same general character. It acts oppositely to tension, heightening the curve of elongation instead of lowering it. This action is certainly not due either directly or indirectly to mere current heating. It has been shown that the thinner wire even when carrying 2 ampères was only about 10·7° warmer than when no current was passing through it. Such a small rise of temperature would be quite incompetent by itself to account for the effect in question, for the elongation curves of a given specimen of iron have been found to be not sensibly altered when taken under widely different conditions of temperature. Nor would it exert any material influence upon the susceptibility of the iron; and, even if it did, the curves would not be affected in the manner observed.

It is hardly worth while attempting to frame an explanation until many more phenomena of the same order have been investigated.

Similar experiments were afterwards made with nickel and cobalt.

Experiment 6.—A nickel wire was used, the diameter of which was 0·65 mm. The retractions which it underwent in fields of gradually increasing strength are given in the second column of Table IV.

TABLE IV.—NICKEL WIRE, diameter 0·65 mm.

Magnetic field due to coil. C.G.S. units.	Retractions in ten-millionths of length.		
	With no current through wire.	With 1 ampère through wire.	Difference.
12	8	8	0
15	10	11	−1
19	15	15	0
28	25·5	25	0·5
36	34	33	1
50	50	48	2
69	74	72	2
84	92	92	0
99	113	112	1
119	134	133	1
150	164	162	2
175	178	178	0
209	196	194	2
256	217	215	2
330	241	240	1

Experiment 7.—A current of 1 ampère was passed through the nickel wire, producing a heat elongation of 340 ten-millionths. Taking the coefficient of expansion as 0·0000129, this implies a rise of temperature of 2·6°. The retractions of the wire when carrying a current are given in the third column of the table. Remembering that the figures in the second and third columns denote millionths of a centimetre, the close agreement between the two is very remarkable. I have elsewhere* fully described the method of observation adopted, but I may perhaps mention that each number as set down in the table was obtained by the subtraction of two readings, the one taken when there was no current in the magnetising coil, the other when the current was turned on. The former or zero reading was continually changing, owing to small alterations of temperature, the index rarely being absolutely at rest. All the figures were dictated, and when the second experiment was made, I had not seen the results of the first. I may add that the table contains *all* the observations which were taken in the two experiments.

Though at first inclined to attribute such small discrepancies as exist entirely to observational or instrumental errors and to infer that the current had no influence whatever upon the contraction, I think it appears pretty clearly from a careful inspection of the differences

* Independent readings of the ampèremeter were taken in the two experiments, and the readings corresponding to the same resistance in both series all agreed within a quarter of a scale division, with the exception of the two last, which showed that the E.M.F. of the battery—seven Grove's cells—was slightly increasing, or rather perhaps that its internal resistance was diminishing. When two successive readings with the same resistance in circuit differed by no more than a quarter of a scale division (equivalent to 3·125 units of magnetising force), the mean of the two readings was taken as giving the true current.

* *Phil. Trans.*, Vol. 179, A., p. 218.

tabulated in the fourth column that this is not actually the case. Four pairs of observations agree exactly; once only the retraction with the current seems to be greater than without it, while in the ten remaining pairs the retraction is slightly greater without the current than with it. It may, perhaps, be fairly concluded that the current has a real but very small effect in diminishing the retraction. Now I have before remarked that the degree of retraction which nickel undergoes when magnetised is materially affected by comparatively small changes of temperature: the retraction of the same specimen has been found to be greater in a cold room than in a warm one, at least in fields up to 400 or 500. Probably this is to be explained by the influence of heat in diminishing the magnetic susceptibility of nickel, the retractions being really the same for the same intensity of magnetisation. Such small effect as appears to be produced by the action of the current may, therefore, be accounted for simply by the rise of temperature (2·6°) which it causes.

Tension has a large effect upon the magnetic retraction of nickel:* it is, therefore, the more remarkable that the action of a current, which operates so markedly upon iron, should in nickel be practically insensible.

Experiment 8.—The results with no current obtained for a strip of rolled cobalt, the length of which between the clamps was 10 cm., and the cross section 1·82 sq. mm., are given in the first two columns of Table V.

TABLE V.—COBALT STRIP, section 1·82 sq. mm.

Magnetic field due to coil. C.G.S. units.	Retraction in ten-millionths of length.		
	With no current through strip.	With 2 ampères through strip.	Difference.
34	1	1	0
50	2	2·5	−0·5
84	4	5	−1
100	6	6	0
119	7·5	8·5	−1
153	11	11·5	−0·5
209	16	16·5	−0·5
331	26	27·5	−1·5

Experiment 9.—A current of 2 ampères through the strip caused a heat elongation of about 600 ten-millionths, indicating, if the coefficient of expansion is taken as 0·0000125, a rise of temperature of 4·8°. The retractions observed while this current was passing are set out in the third column of the table. From an inspection of the differences tabulated in the fourth column, it appears that the effect of the current is to increase the retraction very slightly.

According to Rowland the susceptibility of cobalt is *increased* by heating. The small additional retraction indicated when the current was passing was, therefore, no doubt due to the increased susceptibility consequent upon current heating. It may be noted that tension seems to have no material effect upon the magnetic retraction of cobalt.†

* *Roy. Soc. Proc.*, Vol. 47, p. 469.
† *Loc. cit.*

Summary.

In an iron wire carrying a current, the maximum magnetic elongation is greater, and the retraction in strong fields is less, than when no current is passing. The effect of the current is opposite to that of tension.

The magnetic retractions of nickel and of cobalt are not sensibly affected by the passage of a current through the metals. (Tension considerably modifies the magnetic retraction of nickel, but not that of cobalt.)

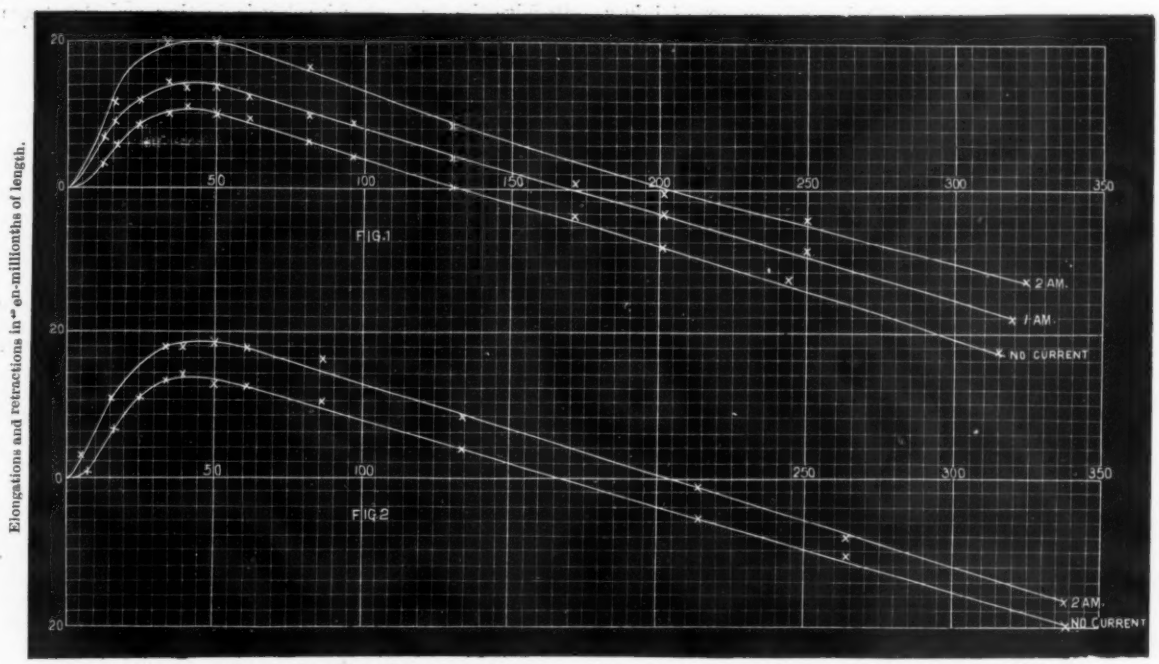


FIG. 1.—MAGNETIC FIELD, IRON WIRE DIAMETER 0·75 MM.

FIG. 2.—MAGNETIC FIELD, IRON WIRE DIAMETER 1·05 MM.

ELECTRIC WIRING.

MR. REGINALD FREDERICK YORKE has devised an improved method of, and means for laying and protecting, wires for the transmission of electric currents for lighting and other purposes, which is designed to give an efficient protection to the wires against damp, in a cheap and simple manner, thus ensuring greater safety from fire, enabling the said wiring to be done by unskilled workmen with great ease, and to be laid with little damage to walls.

Some systems which have been introduced, such as a concentric disposal of a naked return wire about an inner insulated lead, though avoiding the disadvantages and cost of the system of wooden casings, have the drawback of requiring switches, cut-outs, &c., of special design, and elaborate special means for the making of joints in the leads. Mr. Yorke claims that his improved method and means offer a much cheaper and reliable protection than the wooden casing, whilst at the same time the ordinary switches, cut-outs, and fittings, may be used as at present.

Where the electric current is to be distributed for lighting or other purposes in the usual manner, known as the parallel system, he arranges a lead and return conductor in a protecting metallic tubing, which may be of lead, or tinned lead, such as is used for gas. Only the leading or positive conductor is insulated, the bare return wire being laid in the said tubing. Joints for branches, &c., are easily made in the following manner:—The insulated leads and bare returns are soldered to their respective branch wires, and the joint of the positive lead is then covered with tape or other insulating material. The joint in the protective tubing is made as follows: the ends of the tubes enclosing the wires are brought within a short distance of one another, and are connected together by an outside metallic sheathing of lead or tinned lead, made in the form of a T or Y-piece, or of other suitable shape, split as regards one part of the T, or split completely into two parts, so that the connector sheath can be laid over the joint, after the wires have been metallically connected. The split parts of the sheath are then soldered together, and the ends

soldered to the tubes, so as to make the whole joint water and air tight, as in a soldered joint in a gas or water pipe.

The wires are thus entirely surrounded and protected by the metallic covering, and no access of moisture to the wires is possible. No partial faults can therefore occur by moisture, and there is either high insulation or complete short circuit, metal to metal, in which case the safety fuse would act.

Wires can thus be laid in damp places, such as where exposed to the weather, or in wet mines without fear of injury or deterioration and decay to the insulation, and the pipes may be buried in the walls, or between lath and plaster walls, so as to be out of sight, and with little injury to the walls.

NOTES.

The Electric Light in Paris.—According to *La Lumière Electrique*, the number of electric lamps in Paris is about 175,000, lighted from central stations, having an actual 17,500 horse-power.

Khotinsky Lamps.—M. D. Angé, of the Khotinsky Company, has published the result of some interesting experiments he has made on the relative advantage of different efficiencies of incandescent lamps. From these, says the *Electrical Engineer*, it would appear that it is not improbable in the future that lamps at 1·5 and 2 watts per candle might be used with economy. In the ordinary lamps 1·5 watts per candle will only give 55 hours' life, 2 watts 90 hours, and 2·5 watts 150 hours. But the following lives are guaranteed by the Khotinsky Company :—

Initial consumption.					Average life.
1·5	watts	per	candle	... ...	250 hours.
2·0	,,	,,		... ...	350 ,,
2·5	,,	,,		... ...	500 ,,
3·0	,,	,,		... ...	700 ,,
3·5	,,	,,		... ...	1,000 ,,
4·0	,,	,,		... ...	1,200 ,,
4·5	,,	,,		... ...	1,500 ,,
5·0	,,	,,		... ...	2,000 ,,

The Khotinsky Company have been able to obtain this relative long life in the lamps of 1½ and 2 watts per candle by the use of a "protector," to prevent the formation of the blue arc, which generally begins to show, when overrun, between the filaments. Consumers will wish to know if these figures can be maintained in practice, and in what degree the light falls off at the end of the time mentioned.

The Question at Taunton. — As one might have expected, the Taunton Gas Company, as a body of ratepayers, has memorialised the Board of Trade, requesting that the electric lighting license applied for by the Town Council be not granted. The petition asks, however, that if the license is granted, that a clause be inserted making it obligatory on the Town Council to charge for electric light supplied to private consumers a sum that would at least cover the cost of the production and the interest and other necessary expenses. The Electric Lighting Company intended supplying the electricity by meter on and after September 29th, but finding some difficulty in so doing, they have, instead, revised their tariff, and since the date mentioned have charged a higher rate by 2s. 9d. per annum, for every 16 candle-power light. The average price charged for 16 candle-power incandescent lights was 16s. per annum ; the new price will now be 18s. 9d., or an advance of about 16 per cent. This brings the price up to about 8d. per unit, and is in accordance with the recommendation of Mr. Kapp. It was, however, in the private arc lighting that Mr. Kapp found that the principal loss was incurred, 41 private arc lamps being supplied for £410, or about £10 per lamp per annum. The charge, he contended, ought to be £22 10s. If that advance were submitted to it would mean something like £450 more money every year from those who use the electric light in these arc lamps. Until that price is insisted on, the tradesmen who are using these lamps at the old prices are not paying cost price for their light. The decision of the Board of Trade is awaited with considerable interest.

Chelmsford Electric Lighting.—We understand that the wires used for the electric lighting of High Street and Tindal Street, Chelmsford, are being placed underground.

Wolverhampton and Electric Lighting.—A meeting of the Wolverhampton Town Council was held last Monday, when an important report by Mr. W. H. Preece (the engineer) was brought before them. It had already been agreed to advertise for tenders for electric lighting, and Mr. Preece and the Lighting Committee recommend the purchase of a site for a central station at £1,900, plus vendor's cost.

Manchester Electric Lighting.—A few weeks ago we referred to some remarks made by a *Manchester Examiner* correspondent in regard to the electric lighting of that city. The matter was brought up at a meeting of the City Council last week, when Sir John Harwood explained that various difficulties, unforeseen and uncontrollable, had arisen, causing great delay. As far as he could judge, however, the light would be available in the early part of next year.

Bowness and Electric Lighting.—In a recent issue we stated that the Bowness Local Board were considering the application of Messrs. R. H. Fell & Son, Limited, for permission to lay cables for the electric lighting of the streets. At last week's meeting of the Local Board a draft agreement was read and discussed, and approved of. An amendment that the Board themselves apply for a provisional order found no seconder.

Electric Lighting of Public Baths.—The new public baths which have lately been erected at Aston at a cost of £13,000, and which were opened last Wednesday week, are lighted throughout by electricity. The whole of the corridors and private baths are lighted with the Swan-Edison type of incandescent lamps, the first-class swimming bath being lighted by 40 25-candle-power incandescent lamps, arranged in eight clusters of five lamps each. In addition to these there are three lights under the gallery. The front entrance is lighted by two arc lamps of from 700 to 1,000 candle-power each. The second class swimming bath also is lighted by two arc lamps of similar candle-power, with the addition of two pilot lamps for cleaning purposes.

Prize Offered.—A prize of 3,000 francs has been offered by Baron Léon de Lenval, of Nice, to the inventor of the best application of the principles of the microphone in the construction of microphones, or of a portable apparatus for the improvement of hearing in deaf persons. Instruments for competition must be sent to Prof. Adam Politzer, or Prof. Victor von Lang, Vienna, before December 31st, 1892. The prize, says *Nature*, will be awarded at the Fifth International Otological Congress at Florence in September, 1893. If no instrument is judged worthy of the prize, the jury reserve the right of announcing another competition, unless Baron Lenval decides to dispose of the prize otherwise. The following are the members of the jury :—Prof. Adam Politzer (President), and Prof. Victor von Lang, Vienna ; Dr. Benni, Warsaw ; Dr. Gellé, Paris ; Prof. Urban Pritchard, London ; Prof. St. John Roosa, New York ; Prof. Grazzi, Florence.

Electric Construction Corporation.—It is remarkable, as well as interesting, to notice the continual falling there has been in the Stock Exchange quotations of the Electric Construction Corporation shares. Just twelve months ago they were quoted in the official list 7½—8. On Wednesday last the quotation was 3¾ to 4¼. The following is a copy of a letter from "A Shareholder who believes in the Company" appearing in the *Financial Times* of Wednesday last :—"I notice a letter in your paper signed 'An Anxious Proprietor' who wishes to know why the above shares are selling at £3¾. I would say the cause of the recent fall in Electric Construction shares is undoubtedly Mr. Balfour's connection with the corporation. He is no longer chairman or director, however. It is understood that his shares have been pressed on the market and so caused the depression in price, but no harm will accrue to the company through his troubles, and I would certainly advise 'Anxious Proprietor' and all shareholders in the above company not to sell a single share, but stick to them, and they will soon see them at par."

The Chicago Exhibition Electric Lighting.—It was at first estimated, says *La Lumière Electrique*, that 100,000 incandescent lamps would light the Chicago Exhibition, but to-day the figure is nearly trebled. The following is a list of the numbers found necessary for the various bodies of buildings :—Manufactures Building, 28,000 lamps ; Gallery of Arts, 12,600 ; Buildings attached, 18,000 ; Administration Buildings, 15,000 ; Machinery Hall, 7,600 ; Docks, 6,100 ; Agricultural, 5,000 ; Government, 5,000 ; Mines, 4,800 ; Conveyance, 3,200 ; Women's Buildings, 3,200 ; General, 7,300 ; Germany, 500 ; Japan, 500 ; France, 500 ; other buildings, 25,000. In this list there is not included the electricity building, which alone will have 100,000 lamps.

Failure of the Electric Light in Dublin.—In our last issue we referred to the failure of the electric lighting in Dublin, the source of our information being a Dublin newspaper. We have since received the following letter from Mr. Ruddle, the superintendent engineer at the central station :—" Your note makes the disaster appear worse than the facts. A stoker, who was specially selected by the local Stokers' Society, grossly neglected his work, steam being down from 150 normal to 100 lbs. when found out before the bad fire could be remedied and steam raised ; one of the arc circuits with a heavy load had to be shut down. As, however, there are two distinct circuits in each street, the remaining lamps gave some general light, and the time during which the partial extinction lasted was not more than 20 minutes. The incandescent lighting was not affected seriously, a 5 per cent. drop being the maximum for a few minutes. There was no fault with any of the plant, the accident being due to an incompetent attendant, whose services were promptly dispensed with. The lighting, generally, has given universal satisfaction to consumers and the public at large." We are pleased to insert this explanation of the matter.

Elmore.—The Elmore's Foreign Copper Depositing Company commenced business on June 16th, 1889. The first annual meeting was held on December 29th, 1890, at which the accounts to March 31st, 1890, were presented. Although nine months' working should have been included in those accounts, it was stated that little or nothing had been done. The next annual meeting was held on June 29th, 1891. On April 6th and May 1st in that year, meetings were held passing resolutions altering the articles of association ; since that time, however, no meeting of shareholders has been called, and no statement of the company's business placed before them. We can quite understand the *Financial News*' correspondent, whose letter we give below, and who is a shareholder in two of the Elmore companies, thinking it an unreasonable time to be allowed to elapse without the shareholders being called together. It is to be hoped they will move in regard to the matter, and ascertain the reason of the delay. We reproduce the letter referred to above :—" About two months ago I noticed a letter in your paper, presumably written by a shareholder, directing attention to the delay of the directors of the Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited, in calling the annual meeting of the shareholders. I quite expected the letter would have been the means of such meeting being called at an early date ; but, that not being so, I also beg to ask if either you or anyone connected with the company can explain the reason of such delay. It is now about 21 months since the last annual meeting was held, when everything was shown to be in a most prosperous condition, with plenty of money in hand and in prospect for future dividends. Since then the American patents have been sold for a large sum, which would also further increase the prospects of the company, that being so ; but whether the company is prosperous or not, the meeting ought to have been called nine months since, and the dividends, if any, should be in the hands of the shareholders, instead of being hoarded up in the bank. Whilst speaking of Elmores, I think it is an unreasonable time to elapse from the closing of the accounts in June last of the English company, without the shareholders being called together. Hoping this may be the means of eliciting some information from the directors of both companies at an early date." Twelve months ago the shares were quoted on the Stock Exchange at 3—3¼ ; to-day the quotation is ⅝—¾. This speaks for itself to believers in the Stock Exchange.

New Publication.—A new monthly journal has been commenced with the October number, to be known as *Arms and Explosives*, the journal of the ammunition and fire-arms trades. It is to be worked on the ordinary lines of technical journalism.

Electric Lighting on Steamers.—We have often had occasion in these columns to condemn methods of wiring ships, and many cases of culpable negligence have come before our notice. We think, however, the following instances communicated by Mr. James Price to the *North China Daily News* are about as bad as one could find :—

I noticed in your issue of the 16th inst. that the fire that occurred on the *Empress of Japan* was said to be due to the fusing of electric light wires on board. I had the privilege of going over this particular boat some 12 months ago, and I am not at all surprised to hear of this accident, for, at that time, in my opinion, the installation was not by any means perfect. However, the *Empress* in question seems to have been more unfortunate than other steamers fitted up in an inferior manner ; for instance, one steamer, a little while ago, spoilt a portion of her cargo of tea, and another, on her last voyage out to Shanghai, only escaped getting on fire, I am told, by extinguishing her electric lights. In my opinion, electric light is by far the safest illuminant we have at present, *but* care *must* be taken as regards the placing of fuses and their sectional area. I have seen ships running out of Shanghai having wires connected to lamps having a sectional area of sq. mil. 0·656, the fuse wire being a piece of No. 18 B.W.G. *copper* wire, with a sectional area of sq. mil. 1·167, whereas it should have been a No. 22 tin wire, with sectional area of sq. mil. 0·397. The consequence of a short circuit would be that the lamp wire would be fused, and would set fire to the ship, if placed on woodwork.

I know personally of 10 to 14 ships running out of Shanghai, which, if brought under the same regulations as houses, viz., under the Phœnix Fire Insurance Company's rules, would be condemned. All the contacts are made on wood, and the ships are wired on what is known as the ship return.

Insurance companies are, at this time, in consultation with the Board of Trade *re* the framing of rules and regulations for installations on board of ships. Until these rules and regulations are enforced, we must expect to hear frequently of fires from *imperfect* installations.

I am, &c.,
Jas. Price.

August 19th.

Hull and the Electric Light.—The electric light is growing in favour with the people of Hull, and a large number of firms are completing contracts there. Among the separate installations at present completed are two gas-engine plants by Roper's Electrical Engineering Company, of Bradford, who have also obtained the contract for wiring the Town Hall. The larger of the above installations is at the new Grosvenor Hotel, where a Roper dynamo, giving an output of 200 ampères at 100 volts, is driven by a Crossley engine ; while at the Alhambra Music Hall, a Tangye gas engine, driving a smaller dynamo by the same firm, is giving general satisfaction. Besides the above plants, several large shops, and the Grosvenor Arcade, have adopted the electric light in preference to gas, and we note that some local firms have wired several premises in the Old Town, where the Corporation have obtained Parliamentary powers, and are laying down plant for the private supply. The most important work, however, at present being done in Hull, is the laying of the mains in connection with the private supply referred to above. These are being laid by Messrs. Crompton and Co., and are on their system of bare copper strip in concrete channels under the footways. The narrow footpaths—already containing gas, water, telephone, telegraph and hydraulic mains—have rendered this part of the work anything but easy. All difficulties have, however, been successfully overcome, and the work carried out rapidly at the rate of about 300 yards per week, which speaks volumes for Messrs. Crompton & Co., and their engineer, Mr. B. Holmes-Jenkinson, and we understand that the work is now all but completed. The central station is being pushed on, three of Paxman's economic boilers being in position ; Willans-Siemens combined sets, and Crompton-Howell accumulators are to complete the generating and storage plants, and there is every probability that the Corporation will be in a position to commence the supply in a month or two. At present the mains are only laid in what is known as the Old Town, but a petition is on foot from the inhabitants on the other side of the docks for an extension in their direction. The whole of the works appear to be of a very substantial and well-designed nature. Mr. Lewis is engineer to the Corporation, and, as stated above, Mr. B. Holmes-Jenkinson has carried out the work on behalf of Messrs. Crompton & Co.

Award.—The inventor of the Fiske electrical range finder, which has already been described in the Electrical Review, has been awarded the Elliott Cresson gold medal by the Franklin Institute Committee on Science and Arts.

Ealing Lighting.—The Brentford Gas Company have raised the price of gas, with the result that the Ealing Local Board, who protest against the advance, have decided to form a committee to consider the advisability of adopting the electric light.

The City Electric Lighting.—At a meeting of the City Commission of Sewers on Tuesday last, a report was brought up by the Streets Committee relative to accounts from the City of London Electric Lighting Company, amounting to £1,211 5s. 7d. for lighting certain of the public ways of the City up to Midsummer Day, and recommending that the accounts should be paid, without prejudice to the contracts and provisional orders. This was agreed to.

Electric Lighting for Derry.—An important meeting of the Derry Corporation was held the other day when a report from the Lighting Committee was adopted. The report recommended the public lighting by electricity, and that a sum not exceeding £12,500 be applied for carrying out the work. Mr. Blake has been instructed to prepare detailed plans and specification for submission to Dr. John Hopkinson prior to advertising for tenders. Powers have been given to the Committee to purchase a site for station and obtain a loan from the Local Government Board for the purpose.

A Prosperous Undertaking.—The Petroleum Engine Company, which, by the way, has been in existence more than four years, has just declared the princely dividend of 1 per cent. An examination of the company's accounts is exceedingly interesting. The income derived from all sources (nearly all in royalties) during the year ended June 30th, 1892, amounts to £1,633 13s., and for the laborious task of collecting from Messrs. Priestman Brothers, and distributing this enormous sum there has been an expenditure of £615 14s. 4d. The benevolence of the directors of the concern is most conspicuous and exceptional, seeing that they are contented to draw only £400 for the large amount of anxious work that must have been entailed by their holding office.

Light and Health.—An interesting and useful article on the electric light considered from a hygienic point of view has recently appeared in the New York *Electrical Review*. The author does not tell us much that is new, but he summarises the advantages to both body and mind which are to be obtained from electric light as compared with gas, oil, or other illuminants. The difference of temperature in rooms lit with electric light and those lit by gas is shown by some figures supplied by Mr. Henry Lea, of Birmingham, England, who found that while gas raised the temperature near the ceiling of a certain hall 40 degrees in three hours, the electric light only raised it 1·5 degrees in seven hours. Some valuable observations are made upon the effects that the new illuminant has upon the voices of singers and actors during and after their performance "showing that these artists are able to preserve their voice in much better condition and are by 50 per cent. more often in a good voice." "Their throats are not parched and the voices not injured." It is also claimed that the electric light advantageously affects the mind or, at least, the temperament, on the ground that a good light is cheering while a bad one is depressing. That the electric light is good from the hygienic point of view can hardly be disputed by even the ardent supporters of gas interests, but it must not be forgotten that many of these advantages possessed by the "new illuminant" depend upon a proper distribution of the light, its steadiness and the position of the lamps relatively to the eye. In lighting buildings these all essential points are often one or other of them, and sometimes, alas, all, neglected, with a result that is most trying to the temper, if not to the temperament, of all who visit them. Let us take care that our light installations are arranged with due regard to hygienic laws and we can then feel sure that the "new illuminant" will show its great superiority in contributing to the general health.

Lightships and the Shore.—Mr. Allan Stoneham, formerly Registrar-General of Shipping and Seamen, and more lately an assistant secretary to the Board of Trade, has accepted the appointment of chairman of the Committee on Lightships and their construction, &c.

Institute of Mining and Metallurgy.—The first ordinary meeting of the second session of this Institution is to be held on Wednesday next, October 19th, 1892, when a paper read by H. M. Belcher, on June 15th, on "Mining in the Malay Peninsular; a Field for Mechanical Appliances, Hydraulicing and Electric Transmission and Power," will be discussed.

Ilkley and Electric Lighting.—The Ilkley Local Board, which had almost committed itself to the purchase of the Ilkley gasworks, is now considering whether such a step would be in the best interest of the ratepayers. Ilkley is exceptionally well situated for the utilisation of water as motive power for generating electricity; but should the gasworks be acquired by the Local Board, in all probability the adoption of the electric light would be indefinitely postponed.

Some Objections to Aluminium disposed of.—Since the production of aluminium is intimately connected with electricity, it will not be out of place to notice some recent researches by G. Lunge, which tend to contradict certain adverse opinions which have been expressed in connection with the application of this metal to domestic and other purposes. The successful exploitation of aluminium is identified with progress in the adoption of electricity to metallurgy, and it would be a pity if there were any real reason against its extended use. Lunge has been conducting experiments in order to ascertain the action of certain liquids upon samples of commercial aluminium. Chemically clean strips were suspended, so as not to touch each other, and these were immersed in corked flasks, containing, respectively, the following liquids, namely:—Claret, hock, brandy, pure 50 per cent. alcohol, solutions of tartaric, acetic, citric, lactic butyric, boric and salicylic acids, phenol, tea, coffee and beer. After six days, the strips of metal which had been previously weighed before undergoing the treatment, were removed, washed, and weighed and the experiments repeated for another period of like duration. The results are tabulated in a paper published in the *Chemical News*, lxv., pp. 110, 111, but the conclusions are that tea, coffee and beer are practically without action on aluminium, brandy nearly so, whilst the action of acids and acid liquids, although more pronounced, is far too slight to cause any alarm. In the worst case, acetic acid, only 5 mgrms. were dissolved per 100 cc. in six days, and such action in a quart canteen, supposing it always to be full, would only amount to 1 gramme in 200 days. Hence commercial aluminium may be employed without fear, for holding articles of food, at least at ordinary temperatures. It is interesting to notice that the aluminium samples contained 0·55 per cent. of silicon, 0·25 of iron, and a trace of copper. These results completely dispose of certain alarming statements which have recently had some currency on the continent.

NEW COMPANY REGISTERED.

Akester Electric Syndicate, Limited. — Capital £15,000, in £50 shares. Objects: To carry into effect an agreement made between Mr. W. H. Akester of the one part, and Mr. P. R. Low, on behalf of this company, of the other part, for the acquisition of certain patents relating to improvements in electric arc lamps, and to develop and turn to account the same, and to trade as electrical engineers generally. Signatories (with 1 share each): C. T. Praed, 24, Cadogan Place, S.W.; A. R. Dick, Surbiton, S.W.; C. P. Johnson, Annandale, Streatham Common; F. Skipwith, Red Cottage, Harpenden; W. H. Akester, 11, Ward's Avenue, Palace Road, Fulham, S.W.; F. R. Hill, 116, Wandsworth Road, S.W.; H. H. Price, 9, John Street, Adelphi, W.C. The number of directors is not to be less than three nor more than six, the first being the first two signatories to the

memorandum of association, and one other, not named. Qualification, £500. Remuneration, £60 per annum, divisible. Registered on the 5th inst. by Mr. H. H. Price, 9, John Street, Adelphi, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Elmore's American and Canadian Patent Depositing Company, Limited.—At a general meeting of the shareholders of the above-named company, held on May 3rd last, the following resolution was passed, and was confirmed as a special resolution on the 24th of the same month:—"That Clause 92 of the Company's Articles of Association be and is hereby rescinded and annulled." The clause referred to reads:—"The directors shall have full power to execute in the name and on behalf of the company in favour of any director or other person who may incur, or be about to incur, any personal liability, whether as principal or surety, for the benefit of the company, such mortgages or charges of the company's property (present and future), or uncalled capital, as they think fit, by way of guarantee to or for the indemnity of such director or person, and any such mortgage or charge may contain a power of sale, and such other powers, covenants and provisions as shall be agreed on."

Halifax Mutual Electric Light and Power Company, Limited.—The annual return of this company, made up to August 20th, was filed on the 29th of the same month. The nominal capital is £20,000 in £5 shares, of which 1,226 have been taken up and 105 issued as fully paid. Upon each of the remaining 1,121 shares £3 10s. has been called, the calls paid amounting to £3,926, including a sum of £2 10s. paid on five forfeited shares. Registered office, Square Road, Halifax.

D. Hulett & Company, Limited.—The annual return of this company, made up to the 12th ult., was filed on the 16th. The nominal capital of the company is £35,000, divided into 6,900 ordinary and 100 founders' shares of £5 each; 5,900 ordinary and all the founders' shares have been taken up, and 4,000 ordinary and the founders' shares issued as fully paid. Upon 1,900 ordinary shares the full amounts have been called, and all calls (£9,500) paid. Registered office, 55 and 56, High Holborn, W.C.

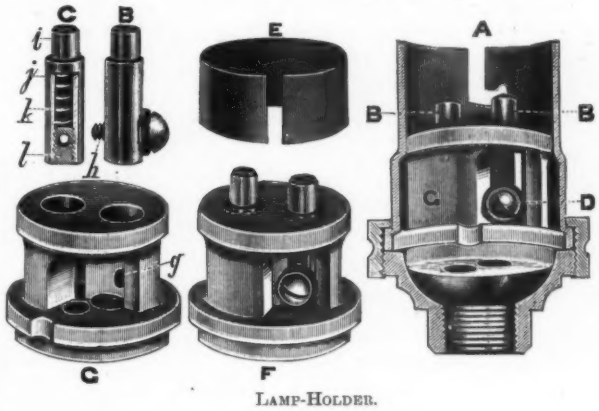
Consolidated Telephone Construction and Maintenance Company, Limited.—The annual return of this company, made up to June 24th, was filed on the 29th ult. The nominal capital is £307,545, divided into £75,000 6 per cent. preference shares of £1 each, 224,850 ordinary shares of 14s. each, and £75,150 ordinary shares of £1 each. 27,637 preference shares and 224,850 ordinary shares have been taken up, the full amount called, and all calls (£185,032) paid.

BUSINESS NOTICES, &c.

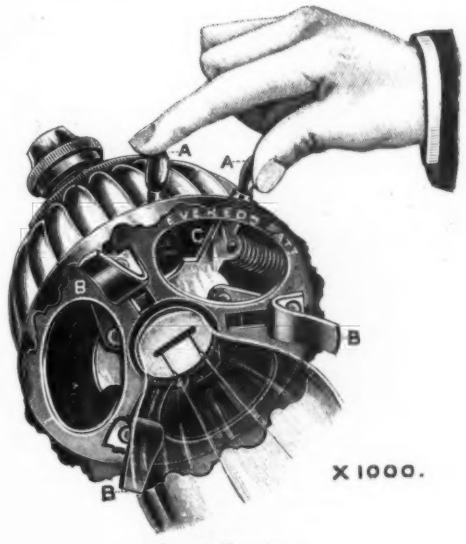
The Electric Date and Time Stamp Company.—According to a notice in the *London Gazette*, resolutions were adopted at meetings of the company on September 27th and October 4th, as follows:—"That the Electric Date and Time Stamp Company, Limited, be wound up voluntarily under the provisions of the Companies' Acts, 1862 and 1867; and that J. M. Henderson, of 2, Moorgate Street Buildings, E.C., be and he is hereby appointed liquidator for the purposes of such winding up."

Electric Construction Corporation.—A dinner was given by Mr. Thomas Parker, some days ago, to the employés of the Corporation who had been there for seven years, to celebrate the erection of the two-thousandth dynamo at the Wolverhampton works.

New Fittings.—Messrs. Evered & Company are introducing a lamp-holder, made under license from the Edison-Swan Company, but fitted with their patent insulator, an adjustable shade-carrier, and a wall connection "plug and socket," illustrations of which fittings we give. The advantages of the new insulation of the lamp-holder appear to be increased facilities for wiring, and perfect immunity from danger of short circuit, or of accidental connection with the fitting. The holes in the insulator are sufficiently large to admit the insulation on the wires, so that there is no danger of bare wires touching beneath the base, and a ring of insulating material surrounds the whole, making an accidental contact with the metal case of holder impossible. The insulator itself, as will be seen, is so substantial that the danger of breakage is reduced to a minimum.

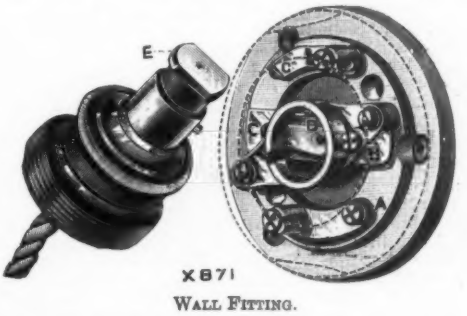


LAMP-HOLDER.



SHADE-HOLDER.

The holder is made in several sizes. The shade-holder illustrated above is arranged to suit any bayonet-joint lamp-holder, which is screwed for a shade ring. To fix the shade press the projections A and A; this will move the jaws, B B B, inward. After fitting the shade into position, release the projections, and the spring, C, will force the jaws outwards, clipping the shade tightly. The large amount of movement in the jaws allow of considerable variation in the size of the shades, and we may say that the weight of the shade has no tendency to close the jaws. The fact that the arrangement does away with the objectionable set screws, should secure for it a good sale. The wall-fitting, fig. x 871, is constructed to avoid as much



WALL FITTING.

as possible the danger of short circuit, by persons introducing into it metal substances other than the proper key or plug. As will be seen from the illustration two movements are necessary to connect the plug with the current, the second movement carries arm C (which has a spring to ensure quick break switchwise to G), and locks the plug, which can only be withdrawn by turning to the left; this action breaks the circuit. A cheaper form is made also with a single pin plug. In both fittings the contact surfaces are very large, so that the danger of heating is small, and both kinds are furnished with a fuse.

Primary Battery Installation.—An installation of a Weymersch primary battery charging accumulators has been at work at Warnham Lodge, Horsham, the country seat of H. Harben, Esq., for the last six months. The installation consists of a Weymersch primary battery, arranged to charge an accumulator of 26 K 11 E.P.S. cells, from which 30 8-C.P. lamps in various parts of the house are fed. The battery is designed to yield 20 ampères at from 56 to 66 volts, a regulating switch on the battery controlling the charging electromotive force. The lamps are arranged on a 50-volt circuit. The battery therefore takes the place of engine, boiler, and dynamo combined; and the simplicity in working, the absence of need for skilled attention, immunity from fire risks or explosion, more than compensate for the extra cost of production. The following figures taken from actual practice show the cost per lamp-hour of the electricity generated by the battery, *i.e.*, not allowing for loss in accumulators:—

About 25 gallons of depolarising solution are used at each charge, which, at 1s. 3d. per gallon, equals	£1	11	3
Six gallons of hydrochloric acid to acidulate the water in the outer cell, at 4½d. per gallon ...		2	3
180 thin zinc plates (which are not entirely used up by one charge), at 3¼d. per plate	2	8	9
Total cost	£4	2	3

The battery will yield from 750 to 800 watt-hours per gallon of solution effectively when charging an accumulator, so about 19,000 watt hours will therefore be obtained from 25 gallons, which works out to 1¼d. per lamp-hour. From this may be subtracted ¼ the weight of the zinc at half the original price, as the syndicate credits the consumers with the value of all scrap zinc returned, or one-eighth of the original price of zincs, say 6s., so that the cost of production from actual practice for materials may be said to be between 1¼d. and 1½d. per lamp-hour of 8 C.P. The working of the battery gives complete satisfaction. The installation has been designed and carried out under the direction of Mr. Ed. C. de Segundo, A.M.I.C.E., consulting engineer to the syndicate.

The Electric Light in the West End.—A number of new contracts are at present in course of completion in this district, though the amount of work is probably not so large as it has been recently. Amongst the new work in hand, we may mention that Messrs. Smeeton & Page, of Queen Victoria Street, E.C., are fitting up the premises of Mr. J. Marcus, 32, New Bond Street.—Fitting work is being done at 77, Grosvenor Street, by Messrs. Parkinson and Son, of 11, Gloucester Road, W.—Messrs. Laing, Wharton & Down are engaged on some work at 16, Upper Brook Street.—Work is in hand at 26, Bruton Street, by Messrs. Crompton & Co.—Messrs. Drake and Gorham are at work at 1, Chesterfield Street.—Messrs. Frank Suter & Co. are fitting up premises at 18, Berkeley Square.—Messrs. Mayall, photographers, have taken some new premises at 73, Piccadilly, and the contract for the electric lighting is in the hands of Messrs. H. F. Joel & Co.—Electric lighting work is also in course of completion at 2, Saville Row, and in the new premises of the Grafton Fur Company, 164, New Bond Street.—Mr. J. O. Grant, of Finsbury Pavement, E.C., has the contract for the electric lighting of a large block of residential chambers now being erected in Southampton Row.—Messrs. Drake and Gorham are putting up fittings in the residence of Lord Knutsford, 75, Eaton Square, and also one in the residence of Mr. James Lowther, M.P., 16, Wilton Crescent.—Messrs. Miller & Woods, of Gray's Inn Road, are fitting up 8, Upper Wimpole Street, W.

Benham & Froud.—An interesting event in connection with the Chandos metal works, took place at Cloots's restaurant, Victoria Street, on Saturday evening last, the spacious saloon being filled to the utmost, with past and present employés and a number of other friends. The occasion was a concert and presentation in honour of Mr. J. W. Froud's jubilee, his advent at the works having occurred in 1842, the firm being then R. & E. Kepp, and his association having extended through a long partnership with the late Mr. Augustus Benham, and finally, and at present, as a director of Benham and Froud, Limited. Mr. Laws, one of his co-directors, who has acted as hon. sec. to the Jubilee Testimonial Fund, gave an outline of its origin, and of the committee's proceedings, after which Mr. Herbert Benham requested Mr. Froud's acceptance of the gifts, which consisted of a silver centrepiece for flowers and fruit, a very easy chair, and an address beautifully illuminated (the design and voluntary work of Mr. Thos. Cond), the presents being then formally handed to the recipient by one of the oldest braziers in the works. A smoking concert followed.

The Electric Light in St. Pancras.—Good progress continues to be made in this district with the adoption of electric lighting for both public and private purposes. Arrangements are in hand for lighting Hampstead Road, High Street, Camden Town, and several of the other principal streets in the district. As regards the private installation work at present in hand, we notice that Mr. Henry Conolly, of 42, Hampstead Road, has the contract for wiring the premises of Mr. Edward Hathway, 95, Tottenham Court Road.—The Electric Power and Traction Company, of Kentish Town, are fitting up the premises of Mr. J. McKnight, 290, Euston Road, while Mr. Julius Sax, of Ridgmount Street, W.C., has the contract for wiring a large block of new residential chambers, now approaching completion, in Frances Street.

United Asbestos Company.—The boilers and pipes of H.M.S. *Sappho*, which recently made a very successful trial trip in the North Sea, were covered with the United Asbestos Company's non-conducting composition. The boiler and pipes of H.M.S. *Scylla* are now being covered with the same company's material. The working pressure in each case is 160 lbs.

Tenders Accepted—Bradford.—The Markets and Fairs Committee of the Bradford Town Council last week considered three tenders, submitted by Messrs. Ullathorne & Edmondson, Woodhouse and Rawson United, Limited, and Andrews & Preece, Limited, for fitting up Kirkgate Market with the necessary appointments for electric lighting. A contract was not finally closed with any one of these firms, but the proceedings which took place made it clear that the general feeling of the committee is in favour of the use of the incandescent in preference to the arc light. At last Tuesday's meeting of the Council, it was agreed to accept the tender of Messrs. Andrews and Preece, Limited, for lighting Kirkgate Market with incandescent lamps, the price being £1,440.

Tenders Accepted—Portsmouth.—The following are particulars of the tenders received for the erection of an electric lighting station in the Gun Wharf Road, Portsmouth, for the Urban Sanitary Authority:—

T. W. Quick, St. John's, Victoria Road, Southsea	£8,400	0	0
M. W. Evans, Southsea	10,270	0	0
T. P. Hall, Southsea	9,425	0	0
M. W. Learmouth, North End	8,367	5	5
E & A. Sprigings, Stamshaw	9,300	0	0

The tender of Mr. T. W. Quick has been accepted.

Tenders Accepted—Derby.—The Electric Lighting Committee of the Derby Corporation have accepted tenders for the erection of the new electric lighting station, and the engines, dynamos, &c., as follows:—For the building, Messrs. Walkerdine & Co., £5,870 4s. 3d. (engineers' estimate £5,600); engines and dynamos, Siemens Brothers, London, £10,871 (engineers' estimate, £10,500). The engineers are Sir Frederick Bramwell and Harris.

Tenders Accepted—Blackpool.—The contract for the Blackpool electric lighting station has been placed with Messrs. Hammond & Co., of Bishopsgate Street, London.

Tenders Wanted—Southport.—In our advertisements will be found particulars of tenders which are being invited by the Southport Corporation. The tenders are for the supply and erection of electric generating plant at the electric station, Crowlands, and for cables to be laid in the streets. The following are some of the sections to be tendered for, and firms may tender for the whole or any of the items:—Boilers and their accessories, engines and ditto, electric generators, switchboards, exciters, condensers, station lighting transformers, high tension mains, distribution mains, travelling crane. The latest date for the receipt of tenders, which must be directed to Mr. J. Davies Williams, Town Clerk, Town Hall, Southport, is Monday, November 14th.

The Electric Light in South London.—Several electric lighting contracts have been carried out in this district since our last report, among which we may mention some work in the "Obelisk" surgery, 10, Westminster Bridge Road, S.E.—An installation has been put in the Camberwell public baths and washhouses, which have recently been completed and opened in Church Street, Camberwell, by the Camberwell Commissioners. In connection with the baths there is a large clock constructed by Mr. J. W. Benson, of Ludgate Hill, E.C. The dial, which is 4 feet diameter, is of opal glass, illuminated by four electric lamps. The complete installation comprises 280 lights, the swimming baths being illuminated by means of 5-light electroliers, suspended from the roof, and the private washbaths by pendants from the ceiling.

A New Catalogue.—A very useful catalogue for those trading in electric lighting plant and fittings in general, is one which has just been issued by the well known firm of B. Verity & Sons. The book is well printed and neatly set out and numerous engravings are given. A deal of space is devoted to the description of engines, boilers, and dynamos, and electric mining machinery, accumulators, lamps, lamp shades, cables and wires, switches, engineers' sundries, measuring instruments, and transformers, and a large variety of other electrical apparatus are fully treated with. The catalogue is a large sized one, 11 inches by 15 inches, of 110 pages, bound in a limp cloth cover, and as a compendium of electrical appliances, seems very complete.

Personal.—Mr. Walter Leake, consulting electrical engineer, of 30, Victoria Buildings, Manchester, and 35, Dame Street, Dublin, has been retained by the proprietors of the Gresham Hotel, Sackville Street, to prepare the necessary specifications and superintend the erection of the electric light on their premises, the same to be connected with the Corporation of Dublin's electric supply system. Mr. Leake has also been engaged as consulting engineer by Messrs. Todd, Burns & Co., wholesale drapers, of Mary Street, Dublin.

Electric Lighting of the Vaudeville Theatre.—Messrs. Mather & Platt, Limited, of 16, Victoria Street, have carried out the lighting of this theatre, the number of lights in the building being 260 lamps of 16 C.P. in the stages, 130 lights in the auditorium and dressing rooms, and 10 100-C.P. lamps in the central dome light. The whole of the contract, including the supply of fittings, resistances for stage lights, &c., has been completed in the short space of 12 days.

New Business.—Mr. James Taylor informs us that he has ceased his connection with the Taylor & Tucker Art Metal Company, Limited, and has started business again at 42, Lamb's Conduit Street, Theobald's Road. With the plant put down, Mr. Taylor says he is prepared to supply the same class of work as was supplied by the Taylor & Tucker Company, whilst he was managing their factory, and at lower prices.

Gilbert & Co.—Messrs. Gilbert & Co., of 35, High Street, Kensington, are fitting up the electric light at Messrs. Straker's large stationery shop in Ludgate Hill.

CITY NOTES.

The Petroleum Engine Company, Limited.

The directors' report for the year ending June 30th, 1892, to be submitted at the meeting of shareholders to be held on the 19th day of October, 1892, at the offices of the company reads as follows:—

"The accounts show that the royalties received for the year amount to £1,629 8s. The increase in the royalties earned this year has taken place largely in the two last quarters, showing that the steady increase in the number of engines sold is continuing in a satisfactory manner. During the past twelve months many engineering firms have made attempts to bring out petroleum engines in competition with the Priestman oil engine. Several of these were exhibited at the Royal Agricultural Society's Show, held at Warwick in June last, but no award was obtained. This shows that the Priestman oil engine continues to hold its position as the only reliable oil engine in the market. The keen competition amongst various manufacturers of gas engines, due in large measure to the running out of the most essential patents connected with the "Otto" gas engine, and the consequent reduction in the price of gas engines, has had its effect in influencing some orders where the gas engine came into competition with the oil engine. This makes it specially satisfactory that the demand for the Priestman engine continues to increase, and the directors have every reason to believe that such will be the case in the future. The directors are glad to report that they have succeeded in arranging for the manufacture of engines in Canada on advantageous terms as to royalties. The amount standing to the credit of revenue account, including the amount brought forward from last year's account, is £1,197 13s. 7d. The directors recommend the declaration of a dividend on the 18,754 shares in the company at the rate of 1s. per share, free of tax, for the year ending June 30th last, which will absorb £961 2s. 3d., leaving the balance of £236 11s. 4d. to be carried forward to next year's account. The retiring directors are Mr. Henry Pawson and Mr. Ernest Moreton, who are eligible for re-election. The auditors, Messrs. E. L. Ernest and Co., retire, and are eligible for re-election.

The Brazilian Submarine Telegraph Company, Limited.

The directors' report for the half-year ended June 30th, 1892, to be submitted to the thirty-eighth ordinary general meeting, to be held on October 19th, 1892, reads as follows:—The revenue for this period amounted to £111,870 4s. 4d., and the working expenses to £29,557 6s. 10d. After providing £12,880 for debenture interest and sinking funds, and £752 14s. for income tax, there remains a balance of £68,680 3s. 6d.; to this is added the sum of £19,983 4s. 11d. brought forward from December 31st last, making a total of £88,573 8s. 5d. A quarterly interim dividend, amounting to £19,500, has been paid, and £40,000 transferred to the reserve fund, increasing that fund to £579,714 6s. 1d. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 1s. per share, both free of income tax, which together will amount to £26,000, leaving a balance of £3,073 8s. 5d. to be carried forward. The dividend and bonus will be payable on the 20th inst. On July 31st last, the sum of £16,800 was transferred to pay off the 168 bonds of the 1884 issue, drawn for redemption in April last. This repayment reduces the debenture debt to £111,400. The receipts for the half-year include the sum of £1,500 dividend to December 31st, 1891, on the company's shares in the African Direct Telegraph Company, Limited. The Western and Brazilian Telegraph Company's Santos-Chuy section was duplicated on June 7th last, thus completing the duplication of the whole of that company's system from Pernambuco to Monte Video, and giving a direct telegraphic service by duplicate cables between Europe and the River Plate. The various sections of the company's line are in good working order. Sir Henry D. Gooch, Bart., and the Duke de Loulé retire by rotation at this meeting, and being eligible for re-election as directors, offer themselves accordingly. The auditors, Mr. Henry Dever and Mr. John Gane also offer themselves for re-election.

The Antwerp Hydro-Electric Motor Power and Electricity Company.

A Belgian financial contemporary contains the following remarks on the prospects of the above company:—"A large number of our readers have asked our opinion of an issue of 9,600 shares by the above company. Our readers should bear in mind the public discussions of nearly two years since, at Brussels, *apropos* of a hydro-electric system for the lighting service of Brussels. We will discuss the scientific value of the processes which are about to be tried to successfully carry out this important question. We may, however, be permitted to state that all efforts hitherto made to introduce the system to Brussels have failed. Despite the theoretical discussions ingeniously provoked by the promoters of this colossal enterprise, the scheme was rejected. We believe that the authorities of Brussels by this have given proof of much prudence; in short, it appears to us foolhardy to enter definitely upon this important question without possessing in the first instance every guarantee which experience alone can supply. In every case, an enterprise of this nature, which has been rejected, and found, consequently, as offering insufficient guarantees of success, should only be judged with the greatest circumspection. The financial side appears to us far less favourable. No one is ignorant of the fact that there is at present a large amount of available capital. Those who hold that unemployed capital are impatiently awaiting the coming of new and important affairs. Thus, as soon as an issue presents itself for the working of an industrial undertaking, the capital necessary will be easily got together, if it present any chances of success. It is only a question of 9,600 shares of 250 francs, and the necessary capital has not been got for the definite formation of the company. Sufficient subscribers have not been found, even among the promoters of the affair, to subscribe the 10 per cent. required by the law, and which here only amounts to 240,000 francs, the whole capital only being 240,000 francs. This is not a fact to inspire confidence. Hitherto all the companies formed for the working of electric power have only given negative results to the shareholders; and we are not the only persons who pretend that, in a practical and industrial sense, the science has not yet advanced far enough to permit the working of electricity with a hope of gaining a dividend on the capital invested. The shares are issued at par, or 250 francs. We advise a glance through the titles of the different industrial companies, even those which have been in existence for a number of years; a complete account of the low quotations of all these shares will thus be gained, nearly all of them being quoted below their issue price, and even their nominal value. Having regard to these circumstances, we think it our duty to advise our readers to prudently abstain, at least, for the present. We are convinced that after the issue of the shares of the new company, which no one has dared to definitely constitute, it will be possible to procure the same shares at a much lower price."

Since the above appeared in our contemporary, we understand that the first day the subscription list was open 2,383 shares were subscribed for in Antwerp, and as the subscription was to remain open a week, there appeared every prospect of the whole 9,600 shares being taken up.

New Australian Electric Company.

The half-yearly meeting of the shareholders in the New Australian Electric Company was held on August 29th at the registered office, Fink's Buildings, Elizabeth Street, Melbourne; Prof. Kernot, chairman of the company, presiding.

The Chairman, in the course of a verbal report to the shareholders, stated since the last meeting, six months ago, 3,748 extra lamps had been added to the company's mains. The revenue from the lighting and putting up installations had been about £5,000 for the half-year, out of which £1,572 had been paid away as interest, and £2,300 on new plant and buildings. The lighting was becoming general in private houses, and the company had on its books many monthly accounts as low as a few shillings. The chairman also at some length referred to his recent trip round the world, and his inspection of the chief electrical establishments in Europe and America. What he saw showed him clearly that the company was proceeding on the right lines, and that its system was by no means antiquated or obsolete. On the other hand, in most of the stations he visited, the boilers and dynamos were almost identical with those of the company. The company, however, was in want of more capital. They had made a call of 2s. 6d. per share recently, which would bring in about £2,000. Their bad debts for the half-year amounted to only £4 2s. 11d., their business being to all intents and purposes a cash business. The public were ready to take the light, but unfortunately they could not supply it fast enough. During last year they had spent £4,000 in extending their engine-house and upon a new dynamo. That £4,000 was not earning a penny at the present time, but it would eventually return a good profit. During his visit to the Old World, he entertained the hope that on his return to Victoria there would be no difficulty in increasing their capital by some £15,000 or £20,000; but when he landed he found nearly everybody bankrupt. He added that a comparatively small increase in their capital would enormously increase their earnings. The present profits were devoted to paying off the bank overdraft, and at their present rate of progress it would only take a few years to completely pay for their splendid property at Richmond.

The report was approved of, and the meeting then closed.

Crompton & Co., Limited.—The prospectus announcing the issue of 22,000 ordinary shares of £5 each in this company, refers to the progress made during the last few years. According to figures given, the yearly profits, which in 1888 were £6,969, have been more than doubled during the last four years, the amount of profit made in the year ending March last being £15,068. As will be seen from our report of last week's meeting, there is a large amount of work in hand and expected, and there accompanies the prospectus a list of the contracts carried out, and those at present being executed by the company. The subscription list for these new shares opened on Monday last, 10th inst., and closed yesterday, October 13th. At present the directors intend calling up only £1 per share.

The Direct United States Cable Company, Limited.—The board, on Tuesday last, resolved upon the payment of an interim dividend of 3s. 6d. per share, free of income tax, being at the rate of 3½ per cent. per annum for the quarter ending September 30th, 1892, such dividend to be payable on and after the 24th inst.

The City of London Electric Lighting Company, Limited.—We are informed that the letters of allotment and regret in respect of the issue of £200,000 6 per cent. cumulative preference shares, were posted on Thursday last, week.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 9th, 1892, amounted to £896; corresponding month, 1891, £747; increase £112; total receipts to date, 1892, £11,616; corresponding period, 1891, £10,621; increase £995.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 7th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, amounted to £3,851.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.	Closing Quotation, October 6th.	Closing Quotation October 13th.	Business done during week ending October 13th, 1892. Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 –103	100 –103	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	49½ - 50½	50 — 51	50⅝	...
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	90½ – 91½	91 — 92	91⅝	90⅜
2,876,140*l*	Do. do. Deferred	Stock	10½ – 11	10⅜ – 11¼	11⅛	10 1/16
130,000	Brazilian Submarine Telegraph, Limited	10	10⅜ – 11¼	10⅜ – 11¼	11¼	10⅜
53,200*l*	Do. do. 5 p. c. Bonds	100	100 –103	100 –103	101¼	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	103 –107	103 –107	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅞ – 3¼	3 — 3¼	3 3/16	3
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ – 2⅜	2⅛ – 2⅜	2 7/16	2⅛
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	3 7/16	...
50,000	City and South London Railway, Nos. 1 to 50,000	10	2⅛ – 3⅛	2⅛ – 3⅛	3	...
30,152	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152 ...	10	10 — 10⅛	10⅛ — 11	10⅜	10⅛
$7,716,000	Commercial Cable, Capital Stock	$100	168 –173	163 –173	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	⅛ – ⅜	⅛ – ⅜	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos 1 to 20,000	5	5 — 5⅛	5 — 5⅛	5⅛	...
16,000	Cuba Telegraph, Limited	10	11½ – 12½	11½ – 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	17½ – 18½	17½ – 18½	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3¼ – 3⅜xd	3¼ – 3⅜	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10 xd	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅜ - 12	11⅞ - 12⅛	12 1/16	11 15/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅞ – 15⅛	15 — 15⅛	15⅛	15
70,000	Do. 6 p. c. Preference	10	15⅛ – 16	15⅛ – 16	16	...
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	106 –109	106 –109	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	111 –114	111 –114	113½	112½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15½ – 15½	15⅜ – 15⅝	15⅝	15⅜
70,600*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	103 –106	103 –106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 –106	103 –106	104	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	109 –112	109 –112	111	110
122,400*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	103 –106	103 –106	...	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	103 –106	103 –106	...	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	103 –106	103 –106	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	3½ – 3⅝	4 — 4½	4½	3½
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	⅜ – ⅞	⅜ – ⅞	11/16	⅜
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	2⅛ – 2⅜	2 — 2⅛	2⅛	2⅛
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	1⅛ – 1⅜	1 — 1⅛	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	10½ – 10⅝	10⅜ – 10⅝	10⅝	10⅜
180,042	Do. do. 6 p. c. Preference	10	15⅜ – 15⅝	15⅛ – 15⅜	15⅝	15⅜
150,000	Great Northern Tel. Company of Copenhagen	10	18½ – 19	18½ – 19	18⅝	18 11/16
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 –108	105 –108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	5½ – 6½	5½ – 6½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½ – 10½	9½ – 10½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ – 22½	21½ – 22½	22½	22
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 –104	102 –104	...	...
17,000	Indo-European Telegraph, Limited	25	42 — 44	43 — 45	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	2½ – 3½	2½ – 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	3 7/16 – 3 9/16	3 7/16 – 3 9/16	...	..
10,000	Do. do. fully paid	5	5 7/16 – 5 9/16	5 7/16 – 5 9/16	5⅛	4⅞
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 –108	105 –108	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ – 7	6½ - 7	6⅞	6⅜
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 –105	104 –107	105	...
447,234	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜ – 4⅞	4⅜ – 4⅞	4 15/16	4 11/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	13⅜ – 14½	13⅜ – 14½	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½ – 14	13½ – 14	13⅝	...
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	111 –113	111 –113	...	...
48,000*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	1½ – 1⅝	1⅜ – 1⅞	1⅝	1
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	4½ – 5½	4½ – 5½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	5/16 – 7/16	5/16 – 7/16	...	...
10,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	7⅞ – 8⅛	7⅞ – 8⅛	...	...
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8⅛	8 — 8⅛	...	...
3,381	Submarine Cables Trust	Cert.	116 –121	116 –121	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3½ – 4	3½ – 4	3⅞	...
37,350	Telegraph Construction and Maintenance, Limited	12	44 — 46	44 — 46	45⅜	44⅜
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	103 –106	103 –106	...	...
58,000	United River Plate Telephone, Limited	5	1⅜ – 2¼	1⅜ – 2¼	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	85 — 95	85 — 95	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ – 7½	6½ – 7½	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	100 –103	100 –103	...	...
30,000	West Coast of America Telegraph, Limited	10	3 — 4	3 — 4	3½	3
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	103 –107	103 –107	...	...
64,242	Western and Brazilian Telegraph, Limited	15	8½ – 9	8½ – 9	9	8⅝
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	6 — 6½	6 — 6½	6½	...
33,129	Do. do. do. 5 p. c. Deferred	7½	2½ – 3	2½ – 3	2⅝	...
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 –106	103 –106	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 –106	103 –106	...	...
88,321	West India and Panama Telegraph, Limited	10	1 — 1⅛	1⅛ – 1⅜	1 5/16	1 3/16
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9¼ – 9⅜	9½ – 10	9⅜	9 11/16
4,669	Do. do do. do. 6 p. c. 2nd Preference ...	10	8 — 9	8½ – 9½	8⅞	8¾
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	103 –106	103 –106	...	...
$1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	123 –128	123 –128	...	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	100	100 –103	100 –103	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6 — 6⅛	5½ – 6	6⅛	5⅞

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. BANK RATE OF DISCOUNT.—2 per cent. (April 28th, 1892

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid) 7½—7⅝.—Electric and General Investment, shares of £5 (£1 paid), 2⅜—3⅛.—Founders' shares, 200—225.—Elmore Foreign and Colonial Copper, Founders shares, 6⅜—7½.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 2½—3⅛.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5½, 1st Preference Cumulative 6 per cents., £5 (fully paid), 5⅛—5⅜.—Liverpool Electric Supply Shares of £5 (fully paid), 5 1/16—5 3/16.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—⅛.—Do. 4½ per cent. preference shares of £10 (fully paid), 10—⅛.—Do. Debentures, 103—⅛.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), ⅛—¼.—£9 Preference (fully paid), 2½—3.

LONDON COUNTY COUNCIL.

AT the meeting held on Tuesday last week, the following was brought forward:—

REPORT OF THE HIGHWAYS COMMITTEE, September 29th, 1892.

Notices under Electric Lighting Acts and Orders.

We have to report that, acting under the authority given to us by the council on July 19th last to deal during the vacation with any matters within the scope of our reference which might require immediate action on behalf of the council, we have considered the undermentioned notices, and have, subject to the conditions stated below, sanctioned the works referred to therein:—

From the House-to-House Electric Light Supply Company.

Notices.	Conditions Attached to Sanction of Works.
a. July 30th, 1892, of intention to lay mains on the south side of Old Brompton Road, from The Grove Boltons to Drayton Gardens.	That the company do give two days' notice to the council's chief engineer before commencing the work; that no pipes of a larger diameter than 6 inches shall be used; that the street boxes shall be of the pattern approved by the council; and that, as an additional precaution against accident through defective insulation of the mains, each of the street boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable, and that the outer cover shall be efficiently connected with earth.
b. July 30th, 1892, of intention to lay mains in part of Ashburn Place, east side.	
c. August 15th, 1892, of intention to lay mains in the footpath between Lexham Gardens and Cornwall Gardens.	

From the Kensington and Knightsbridge Electric Lighting Company.

d. July 25th, 1892, of proposed extension of mains in Mills Buildings, Knightsbridge Road.	No conditions necessary.
e. August 23rd, 1892, of proposed extension of mains across, and along part of, Chapel Place.	Do.
f. August 30th, 1892, of proposed extension of mains along both sides of Cambridge Place.	Do.
g. September 2nd, 1892, of intention to lay mains in Montpelier Street.	Do.

From the London Electric Supply Corporation.

h. August 4th, 1892, of intention to lay mains, consisting of concentric lead-covered cables drawn into iron pipes, in Delahay Street.	That the company do give two days' notice to the council's chief engineer before commencing the works; that the mains be laid under the footways, and be kept 9 inches below the under side of the paving wherever it is found practicable to do so; that where the mains cross the carriageways they be kept at the same depth below the concrete or the road material as the case may be; that the positions of the street-boxes, and the mode of construction of them, shall be submitted to and approved by the council's chief engineer; that all pipes or openings from or into the boxes shall be of such shape as to remove all risk of injury to the covering of the cables; that all cables crossing the boxes shall be supported from below in the boxes; that all service lines or small cables shall be protected, where leaving the boxes, by an extra lead covering or by wooden stoppers, and shall also have a copper wire of sufficient size carried from the service to the main cable, in good connection with the lead or iron outer casing; and that the ends of all mains terminating elsewhere than in a box shall be securely protected by iron caps, in addition to any other covering.

From the Metropolitan Electric Supply Company.

i. August 6th, 1892, of intention to lay mains on the east side of John Street, Bedford Row, to the boundary of St. Pancras parish.	That the company do give two days' notice to the council's chief engineer before commencing the works; that the main be enclosed in five-inch iron pipes, and be laid under the footways wherever it is found practicable to do so; that the covers of the boxes to be used shall consist of iron frames filled in with material to suit the paving; and that the works generally shall be of the description approved by the council on October 1st, 1889.

From the St. James and Pall Mall Electric Light Company.

Notices.	Conditions Attached to Sanction of Works.
j. August 6th, 1892, of intention to alter position of mains in York Street.	No conditions necessary.
k. August 9th, 1892, of intention to alter existing mains in Pall Mall.	Do.
l. August 16th, 1892, of intention to alter existing mains in Regent Street and Jeymyn Street.	Do.
m. August 20th, 1892, of intention to alter existing mains in Piccadilly Circus.	Do.
n. August 30th, 1892, of intention to lay mains in Duke Street and King Street.	Do.
o. September 8th, 1892, of proposed alteration of existing mains in Piccadilly.	Do.
p. September 17th, 1892, of intention to lay mains in Great Windmill Street, from Shaftesbury Avenue to Coventry Street.	That the mains be carried into the Shaftesbury Avenue subway by the nearest lateral passage, and that all work in or about the subway be executed under the supervision and to the satisfaction of the council's chief engineer.

From the Westminster Electric Supply Corporation.

q. August 24th, 1892, of intention to lay mains across, and along a part of, the south side of Pimlico Road.	That the company do give two days' notice to the council's chief engineer before commencing the work; that the street boxes shall be similar to those previously approved by the council; and that the covers thereof shall consist of iron frames filled in with material to suit the paving.

We recommend (*a* to *q*) that the Council do ratify the action taken with reference to the above notices.

Northumberland Avenue Subway.

We have, acting under the authority above referred to, given consent to the placing and maintenance by the Post Office Telegraphs Department of an additional four-wire cable in the Northumberland Avenue subway, such consent being subject to the provisions of the agreement between the Postmaster-General and the council with reference to the use of the council's subways.

Notices under Electric Lighting Acts and Orders.

We have considered a notice, dated August 8th, 1892, from the London Electric Supply Corporation, of intention to lay distributing mains, consisting of concentric lead-covered cables drawn into iron pipes, in Savile Row, Old Burlington Street, Cork Street, Clifford Street, and Boyle Street. We see no objection to what is proposed, and we therefore recommend that the sanction of the council be given to the works referred to in the notice dated August 8th, 1892, of the London Electric Supply Corporation, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works, in the carrying out of which only one side of any thoroughfare shall be obstructed at one time; that the mains be laid under the footways, and kept 9 inches below the under side of the paving wherever it is found practicable to do so; that where the mains cross the carriage-ways they be kept at the same depth below the concrete or the road material, as the case may be; that no street-boxes shall be constructed until the positions for, and the mode of construction of, them shall have been submitted to and approved by the council's chief engineer; that all pipes or openings from or into the boxes shall be of such shape as to remove all risk of injury to the covering of the cables; that all cables crossing the boxes shall be supported from below in the boxes; that all service lines or small cables shall be protected, where leaving the boxes, by an extra lead covering or by wooden stoppers, and shall also have a copper wire of sufficient size carried from the service to the main cable, in good connection with the lead or iron outer casing; and that the ends of all mains terminating elsewhere than in a box shall be securely protected by iron caps, in addition to any other covering.

Three notices have been given by the House-to House Electric Light Supply Company (*a*) dated August 15th, 1892, of intention to lay mains in Penywern Road (east side), and in a very small portion of Earl's Court Road; (*b*) dated September 21st, 1992, of intention to lay mains on the east side of Cranley Gardens; and (*c*) of intention to lay mains in Drayton Gardens, from Priory Grove to Drayton Hall. The mains referred to will be laid in 3 inch iron pipes, and the proposed works appear to be unobjectionable. We recommend that the sanction of the council be given to the works referred to in the three notices, dated August 15th, September 21st, and September 24th, respectively, 1892, of the House-to-House Electric Light Supply Company, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works in any of the streets referred to in the notices; that no pipes of a larger diameter than 6 inches shall be used; that the street-boxes shall be of the pattern approved by the council; and that, as an additional precaution against accident through defective insulation of the mains, each of the street-boxes shall be provided with an inner as well as an outer cover, the two insulated from each other as far as practicable, and that the outer cover shall be efficiently connected to earth.

We have also considered a notice, dated September 6th, 1892, from Mr. H. Robinson, on behalf of the Vestry of St. Pancras, of intention

to lay mains, under the provisions of the St. Pancras (Middlesex) Electric Lighting Order, 1883, in Camden Road, Hampstead Road, High Street, and Park Street. These mains are to be laid in 2-inch cast-iron pipes, and the details are similar to those already approved by the council on previous notices of the vestry. We recommend that the council do approve of the works referred to in the notice of the Vestry of St. Pancras, dated September 6th, 1892, under the provisions of the St. Pancras (Middlesex) Electric Lighting Order, 1883.

Two notices of the St. James and Pall Mall Electric Light Company have also been considered by us, the one dated September 9th, 1892, of intention to lay mains in the Haymarket, from Coventry Street to Charles Street, and the other dated September 20th, of intention to lay mains in Duke Street (part of), Bury Street (part of), and Ryder Street. The proposed works are similar to those of this company previously approved by the council. We recommend that the sanction of the council be given to the works referred to in the two notices, dated September 9th and 20th, 1892, respectively, upon condition that the company do give two days' notice to the council's chief engineer before commencing the works, and that the covers of the street boxes to be used be supported on 3-inch York stone.

A notice, dated September 13th, 1892, has been given by the Metropolitan Electric Supply Company of intention to lay a short length of main in Shaftesbury Avenue. The company proposed that this main should be laid under the pavement; but we are of opinion that it should be placed in the subway, from the lateral passages in which the service connections could be carried. We accordingly recommend (*a*) that the council do sanction the works referred to in the notice dated September 13th, 1892, from the Metropolitan Electric Supply Company, upon condition that the main be laid in the subway and enclosed in iron pipes; that the position to be occupied by the main in the subway be subject to the approval of the council's chief engineer; and that the work of placing and of making good any damage that may be done to the subway shall be carried out to his satisfaction. (*b*) That the clerk be instructed to forward to the company a notice requiring that the main referred to in the company's notice, dated September 13th, 1892, shall be placed in the subway of Shaftesbury Avenue.

We have also considered a notice from the Kensington and Knightsbridge Electric Lighting Company, dated September 21st, 1892, of an intended extension of mains in Hans Road. The proposed works are of the usual character; and we recommend that the sanction of the council be given to the works referred to in the notice dated September 21st, 1892, of the Kensington and Knightsbridge Electric Lighting Company.

We have also to report the receipt of the undermentioned notices, given in accordance with the resolution of the council to accept four days' (instead of one month's) notice in respect of the laying of service lines from mains already laid:—

From the House-to-House Electric Light Supply Company—July 25th, to 28, Collingham Gardens; July 29th, to 143, Earl's Court Road; 24, Ashburn Place; August 3rd, to 12, Bolton Gardens; 1, Collingham Gardens; 123, 129, and 143, Earl's Court Road; August 6th, to 33, Richmond Road; 75, Onslow Gardens; August 9th, to 14, Gledhow Gardens; August 20th, to 32, The Grove, Boltons; August 23rd, to 7, Wetherby Gardens; August 25th, to 30, Clareville Grove; August 29th, to 6, Allen Terrace; September 1st, to 6, Roland Gardens; September 3rd, to 5, Cranley Place; September 5th, to 49, Onslow Gardens; September 10th, to The Boltons Hotel, Richmond Road; 30, The Grove, Boltons; September 12th, to Consumption Hospital, Fulham Road; 100, Fulham Road; September 20th, to 4, Gloucester Terrace; 31, Gledhow Gardens; September 26th, to 23, Roland Gardens; September 29th, to 50, Earl's Court Square.

From the London Electric Supply Corporation—July 27th, to 75, Southwark Street; Buckingham Palace Hotel; Burlington Hotel, Cork Street; August 6th, to 4, Adam Street, Adelphi; 36, Bermondsey Street; August 13th, to Canterbury Music Hall; August 15th, to 118, Southwark Street; September 8th, to 38, Old Bond Street; 237, Blackfriars Road; 4, Bruton Street; September 24th, 37, Bruton Street; 210, High Street, Deptford.

From the Electricity Supply Corporation—July 27th, to 433, Strand; July 28th, to 338, Strand; Waterbury Watch Company's premises, Strand; September 8th, to Messrs. McQueen's, Haymarket.

From the St. James and Pall Mall Electric Light Company—July 25th, to 36, St. James's Street; August 5th, to Athenæum Club, 107, Pall Mall; August 8th, to 45, Wardour Street; August 10th, to 12, Clifford Street; 22, Regent Street; August 20th, to 21, Poland Street; August 26th, to 29, Regent Street; August 29th, to Cox's Hotel, 55, Jermyn Street; August 30th, to Duke Street, King Street; September 9th, to 18, Piccadilly; 47, Haymarket; 14, 15, and 16, Grand Pulteney Street; September 22nd, to 1 and 74, St. James Street; September 27th, to 54, Regent Street; 18, Great Marlborough Street; Willis's Rooms, King Street.

From the Kensington and Knightsbridge Electric Lighting Company—August 12th, to 43, Ennismore Gardens; 3, Hyde Park Gate; September 9th, to 55, Cornwall Gardens; 1, Cornwall Mansions; September 17th, to. 15, Princes Gate; September 22nd, to 10, Cambridge Place; new Brompton Schools; September 29th, to 80, Gloucester Road.

Woolwich Electric Lighting Order, 1891.

We recommended on July 19th last, with reference to an application to the Board of Trade for a further extension by six months of the time within which the undertakers under this order should make the deposit required by section 7 of the order, that the Board should be informed that the council had no observations to offer upon the application. This recommendation was adopted. We have now to report that an intimation has been received that the Board of Trade has acceded to the application, and that the time for making the deposit has been extended to February 5th, 1893.

Wandsworth District and Camberwell Electric Lighting Orders. 1891.

We reported, on July 5th last, that the undertakers under these orders had failed to satisfy the Board of Trade of their ability to discharge their duties and obligations, and that the Board proposed to revoke the orders. Notices have since been received from the Board of Trade that the orders have been revoked as from July 25th and August 26th last respectively.

Victoria Embankment—Lighting.

We have considered a letter from the Surveyor, Metropolitan Police Office, calling attention to the want of light on that part of the Victoria Embankment in front of the new police headquarters, and asking that an additional lamp may be placed there. Although the electric light will eventually be installed on the Embankment, in accordance with the resolution of the council of June 28th last, some time must necessarily elapse before that can be done. There is no doubt that more light is required at the point referred to; and being of opinion that an additional gas lamp, the cost of which, including erection, will be about £12 10s., should be placed there without delay, we have given instructions for this to be done. We recommend that our action be approved.

Queen Victoria Street and Victoria Embankment Subways.

We have considered an application made by the New Telephone Company for permission to place telephone cables in the council's subways from the Mansion House to Westminster Bridge. There appears to be no objection to the placing of the cables in the subways, subject to proper conditions for the protection of the council; and we recommend that, subject to the council's bye-laws and regulations, permission be given for the placing by the New Telephone Company of telephone cables in the Queen Victoria Street and Victoria Embankment subways, upon condition that the company do enter into an agreement, to be prepared by the council's solicitor, to pay a rent in respect of the use of the subways according to the scale laid down by the council, and upon the further conditions that the company shall submit proper drawings showing the space to be occupied by the cables and the proposed method of fixing them in the subway; that all work in and about the subways shall be done, and any damage that may be done to the subway in the execution of the work shall be made good, under the supervision and to the satisfaction of the council's chief engineer, and at the cost of the company.

Inspectors of Subways.

The council on July 7th, 1891, appointed E. Mountain as inspector, and P. W. Crane as assistant inspector of subways, at the weekly wages of 35s. and 26s. respectively, the appointment in each case being on probation for 12 months, and subject to confirmation at the end of that time. We are of opinion that it is advisable that these appointments should not be confirmed until after the expiration of a further period; and we recommend that the appointments of Mountain and Crane be continued on probation until July 7th, 1893, and be subject to confirmation on or about that date.

Adjourned Report of the Asylums Committee, August 2nd, 1892.

The reception of the following report, brought up to the council on September 27th, was postponed.

Claybury Asylum—Electric Lighting.

We have to report that we have, during the recess, considered the tenders for the above, which were opened by the council on July 26th last, and that after most careful consideration, we have accepted the tender of Messrs. Latimer Clark, Muirhead & Co., for the sum of £15,130. This tender was the third lowest.

THE LEEDS ARC LIGHT SYSTEM.

Judging by the scant display at recent electrical exhibitions, one is led to the conviction that there are still only two or three important types of arc dynamos for series lighting, and that these have experienced little, if any improvements during the past few years. In all probability, these machines are as perfect as their peculiar design and construction warrants, but it is of the rarest occurrence that results of tests with such dynamos are placed before the public. Of compound wound and shunt wound dynamos for incandescent lighting, or for running arc lights in parallel, there are innumerable types in the market, all claiming the highest possible efficiency. Arc lamps are, as a rule, only used for the lighting of streets, large open spaces, public buildings and factories possessing lofty rooms. In such cases the distribution of the current to the lamps, if placed "in parallel," involves a capital outlay for copper leads often exceeding in cost the value of the electric generators and lamps combined, even when allowing a very considerable loss of energy in transmission. These facts are well known to electrical engineers, and wherever possible, "series" arc lighting is resorted to for economic reasons. The following is a short description of a system of series arc lighting evolved by one of the best known engineering firms in the kingdom, Messrs. Greenwood & Batley, Limited, of Leeds,

who have spared no pains in producing a highly efficient, compact and economical apparatus, which only requires to be seen in order to be fully appreciated. Fig. 1 shows the general arrangement of a 20-light dynamo with the regulating gear attached. By fig. 2 we can trace the circuit represented in diagrammatic form. The field-magnet poles of the dynamo have two small projections which serve as a magnetic field to a little flat ring, armature M, which is provided with an ordinary commutator and a pair of brushes receiving a weak current through an automatic reversing switch. This switch consists of an electro-magnet

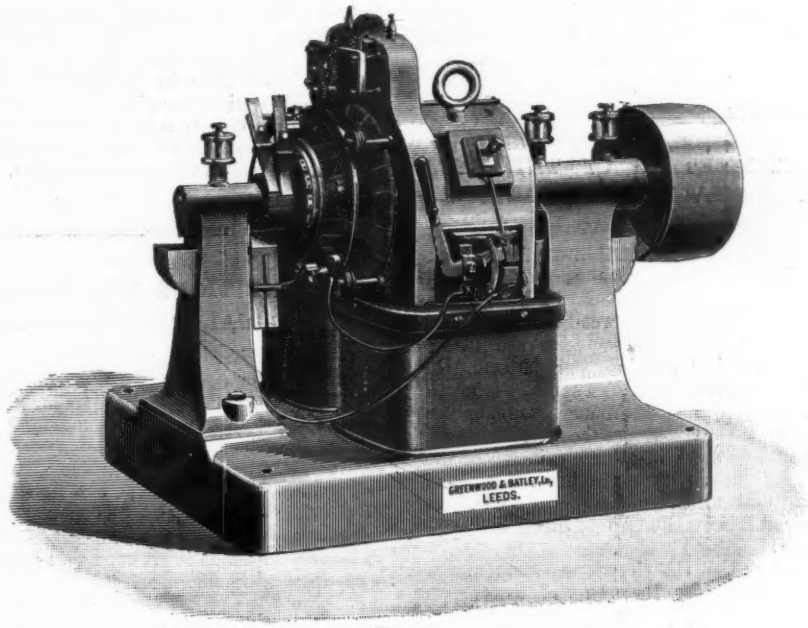


Fig. 1.

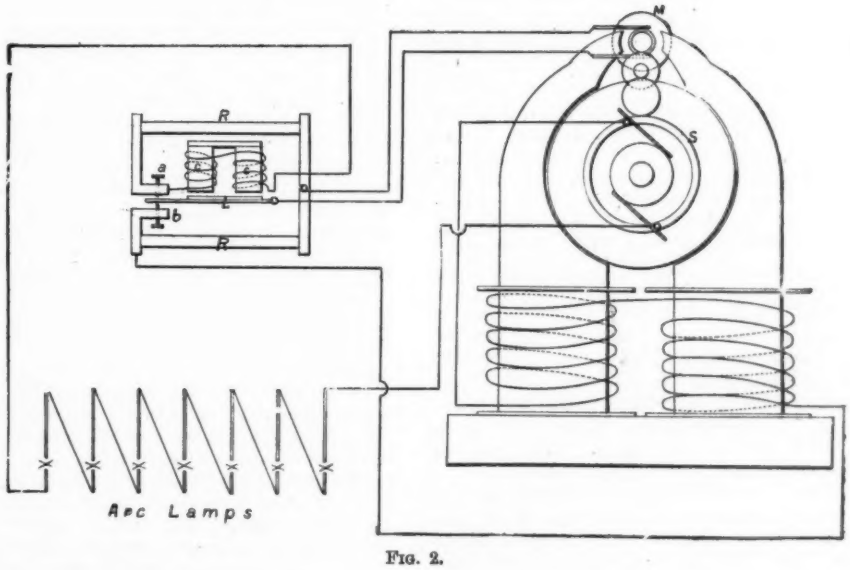


Fig. 2.

energised by the main current, an armature, L, which can make contact with either of the terminals, *a* and *b*, and two resistances, R, consisting of carbon rods about ½-inch in diameter, and some 6 inches long. The slightest variation of the electromotive force in the main circuit will cause the armature, L, to make contact through *a* or *b*, as the case may be, and send a current through the armature, M, in one direction or the other, and thus cause the latter to revolve forwards or backwards. By virtue of this rotation of M, the circular rack, S, supporting the brush-holders of the dynamo, will move slowly (it being driven through a small train of wheels geared to the spindle of M), and thus adjust the position of the dynamo brushes to suit the electromotive force demanded by any number of arc lamps arranged in series. Contrary to the expectations of some electrical experts, there is no "hunting" in the regulating gear; the energy used in actuating it is exceedingly small, and the efficiency of the whole machine at various loads remarkably high. The following tests, made on a 20-light machine, will show this most clearly. The machine was driven by an electric motor, the brake H.P. of which was easily ascertained, running at a constant speed of 750 revolutions per minute. The current was constantly at 10 ampères, and the average voltage measured 47 volts per lamp.

Tests of the Leeds Arc Dynamos.

Number of lamps. 2,000 N.C.P.	Speed. Revolutions per minute.	Current. Ampères.	Brake H.P. absorbed.
5	750	10	6·31
6	"	"	6·98
8	"	"	7·81
12	"	"	10·65
16	"	"	13·1
20	"	"	15·2

The regulator absorbs only 21 watts, or about ¼ per

cent. of the maximum load—quite a negligible quantity. There is no sparking at the contact maker, and, when once adjusted, the automatic regulator will act promptly, and without any further attention, except an occasional dusting. By the "Leeds" arc light system it is possible to run incandescent lamps in series with arc lamps. Such incandescent lamps, of course, must use the same current as the arc lamps, and they are fitted with holders and switches to be put in and out at will. The economy, simplicity and utility of having both arc and incandescent lamps run in series from the same dynamo will be appreciated, especially in such cases as the lighting of mills, factories, and public halls, where the greater part of the lighting is done by means of arc lamps, but where a few incandescent lamps would be useful in offices and rooms forming part of the premises.

TENTH ANNUAL MEETING OF THE NEW YORK STREET RAILWAY ASSOCIATION.

The tenth annual meeting of the Street Railway Association of the State of New York was held at the Saratoga Springs on the 20th of last month. The president in his address stated that the year had been without special incident so far as the street railway interest of the State was concerned, and he confined his remarks chiefly to a few practical matters. He pointed out that street railway companies had begun to realise that a liberal policy paid better than a parsimonious treatment of the public; and he added that the introduction of the transfer system in Rochester had largely increased the traffic returns of the company; yet, perhaps, the local conditions prevailing in other cities may prevent the success of a transfer system; but it is worthy of note that it had been successful in Rochester.

Experience was showing that the electric services required men of higher capacity to perform the duties of motor man and conductor than seemed to be necessary with the old system. It appears to require more judgment and skill to properly handle the electric cars. The Rochester Railway Company had advanced the men's wages without an increase being requested. This action gave great satisfaction to the men, and although the item "wages of employés" had been materially increased, the cost per mile of operating the road had been diminished. This is accounted for by the fact that men are more attentive to duty than before, and more careful in the handling of cars, and so there is greater freedom from accidents and a decreased cost of maintenance.

The president also advocated the appointment of instructors to teach the motor men their duties: the instructor to ride with motor man after motor man, and to observe the manner in which he handles his car, and to give detailed instruction whenever the usual sort of trouble develops.*

A paper was read "On Recent Improvements in Electric Traction," by Mr. L. H. MacIntyre. It was shown that the storage battery had made but little progress during the past year. In electric equipments the greatest advance had been made in the design of motor armatures, and it was stated that the introduction of the ironclad type of motor was likely considerably to reduce the bill for repairs. This form has now been standardised by the chief supply companies. The time-honoured rheostat for controlling the motors was used by most of the railway companies in preference to the field regulation. The motor trucks had been greatly modified, and that known as the "post form" in which the truck was complete in itself was the most favoured. The car body was connected with the truck only by springs, thus being entirely free from the pounding of the truck and the grinding of the gears. Owing to the high speed attained it was necessary to use auxiliary springs at each extremity of the truck in order to check the oscillation of the body. Both coil and elliptical springs had been used for this purpose with marked success, and it is now possible to carry a 28 feet car practically without any oscillation. This improvement is likely to do away with double bogie cars. Improvements had also been made in the style and proportion of the car bodies which were now specially designed for electrical purposes. This has materially lessened the cost of running and maintenance, chiefly by facilitating the inspection of the motors without withdrawing the cars from the road. There has been a general improvement also in the construction of the overhead line. Stiffer poles, stronger span wires, and better trolley wire insulators are in use, and the insulation is far superior to that obtainable two years ago. The method of feeding the line by dividing the system into several sections had much improved the general service; but, perhaps, the greatest improvement of all had been made in the power station. Countershafting had been dispensed with, and the tendency was towards the reduction of parts. For medium sized stations engines with releasing valve gear belted direct to a multipolar dynamo were the best if the price of land was not excessive, but for larger stations direct-coupled engines and dynamos were preferable. Comparative tests as to the economy of the various types of stations were yet lacking but all reasoning points to these latest types as the most economical.

* We have strongly advised the necessity for employing a better class of man than the average tram driver, and fully concur that his pay should be higher. The instructor is also a necessity.—Eds. Elec. Rev.

THE CONDITIONS AND REQUIREMENTS OF A PRACTICAL CONDUIT TROLLEY SYSTEM.

The requirements of practice have demonstrated that although the trolley system satisfactorily fulfils the conditions of many tramways, yet in crowded thoroughfares the overhead wires are inadmissible. The conduit system is thus worthy of serious attention, if only pending the development of the self-contained car, which is, undoubtedly, the ideal method of traction. This has been strongly recognised, and several schemes have been proposed in which the conduit system is to be used in the more crowded thoroughfares, and the trolley wire where the traffic is less heavy. Such a scheme has been laid before the Corporation of Bradford, and it seems by no means improbable that the municipal authorities of Glasgow would be prepared to give their serious attention to a similar proposal. Seeing, then, that the time has arrived to discuss the practical bearings of a conduit-trolley system for use in Great Britain, an article on this subject by Mr. R. J. Hewitt, which recently appeared in the *Electrical Engineer* of New York, is worth our readers' attention. This gentleman has designed what he calls a practical conduit-trolley system, and he has promised a description and plans at an early date. He now discusses only the essential requirements. If the use of the slot rail be admitted by the Board of Trade and the local authorities, as is probable, the chief difficulty will lie with the drainage. This, Mr. Hewitt points out, opens up the question of responsibility, and demands the co-operation of the local authorities with the street car companies in perfecting the surface draining of the streets. If the drainage be properly arranged, there need be little difficulty in most cases from this cause.

The cleaning of the conduits will require large quantities of water to flow for short periods of time daily. And on levels where the flow of water is not sufficiently strong to carry away the dirt, scrapers will necessarily have to be used, as is now the practice with cable roads.

The experience gained in the construction of conduits for cable railways, has shown that the concrete conduit, supported by iron or steel yokes, is both strong and durable, and the cross-section usually adopted allows ample room for the support and insulation of the conductors and feeders. The insulation presents some little difficulty, but Mr. Hewitt proposes to overcome this by placing man-holes at each insulator, so that the accumulation of dust and dirt may be frequently removed. The next question discussed is the use of a single or double conductor. Taking into consideration the advantages and disadvantages of each system it seems probable that a single conductor is likely to prove not only cheaper but also more efficient. So far, in nearly all conduit work bar conductors have been used. But this plan necessitates expansion joints and a relatively large number of insulators; whereas a wire has the advantage of obviating the expansion difficulty and requires fewer insulators.

The contact can be either above or below the wire, but experience seems to suggest that it should be made on the

top. The contact device must be adapted to run in either direction without adjustment and must be easily attached to, and detached from the car, so as to provide for through traffic between conduit and overhead systems; and slot rail gates must be provided at suitable points on the line for the removal of the contact device when it is necessary to transfer rolling stock from one track to another from any cause.

If these points be attended to it seems that the success attained with the overhead systems would be also realised with the slot rail. We await the details of Mr. Hewitt's scheme.

JOINTS IN MAGNETIC CIRCUITS.

In the *Philosophical Magazine* for September, 1888, there was a paper, by Prof. Ewing and Mr. Wm. Low, in which they described some experiments made for the purpose of examining the influence of a plane of transverse section in an iron bar which formed part of a magnetic circuit. They found that a transverse cut introduced what is now frequently spoken of as "magnetic resistance," even when the faces at the cut were scraped up to as nearly as possible true planes, and were brought into excellent mechanical contact. Only when a very considerable force was applied to press the cut faces together did the resistance at the joint appear to vanish; except in this case it required a stronger magnetomotive force—a greater number of ampère turns in the magnetising coil—to bring the magnetic induction up to any assigned value when the bar was cut than it had required when uncut. In this respect the joint is equivalent to a narrow crevasse of air or other non-magnetic material.

Prof. Ewing and Mr. Low proceeded to calculate the width of the air-gap, which should be equivalent in magnetic resistance to the joint, and they obtained values which made it appear that the width of this equivalent air-gap became reduced when the magnetisation was forced up to high values.

Having had occasion recently to revise these results, Prof. Ewing has found that an incorrect procedure had been followed in calculating from the experimental data the width of the equivalent air-gap. It seems strange that this error should have escaped notice for about four years; but now that it has been detected, Prof. Ewing hastens to make the necessary correction.

When the necessary correction is made it appears that the width of the air-gap remains constant, or nearly constant, whether the magnetisation be weak or strong.

The current issue of the *Philosophical Magazine* contains a seven-page paper by the Professor, in which he carefully points out the error in the former calculation and states the corrected values. He shows how he omitted to take account of the variation which the permeability of the iron undergoes when there is, and when there is not, a joint introduced into the iron circuit. He also describes a better method of looking at the problem, which is to draw a curve of magnetisation in relation to magnetomotive force for each of the two cases considered, and then to find by measurement from the curves what is the difference in magnetomotive force for one and the same value of the induction. This simplifies matters by securing that μ, the permeability of the iron, shall be the same when there is a joint as when there is none.

The paper is illustrated by curves, and there are many tables of results. Some of our readers will doubtless find it repay them to consult the original paper.

NEW PATENTS—1892.

17,151. "Improved 'wall,' 'table,' or floor connection for portable electric lamps." A. P. Lundberg. Dated September 26th.

17,160. "Improvements in telephone switchboard apparatus." J. E. Kingsbury. (Communicated by the Western Electric Company, United States.) Dated September 26th.

17,169. "Improvements in or relating to the electrolytical decomposition of metallic salts, and in apparatus therefor." C. Kellner. Dated September 26th.

17,205. "Continuous electric current machines and motors." W. Aldred. Dated September 27th.

17,207. "An improved ear piece for telephones." T. Johnstone Dated September 27th.

17,209. "Improvements in the slides of electric sliding pendants." R. H. Best. Dated September 27th.

17,222. "Improvements in or relating to electric metal working or welding." W. P. Thompson. (Communicated by C. L. Coffin United States.) Dated September 27th. (*Complete.*)

17,223. "Improvements in or relating to welding or working metals electrically." W. P. Thompson. (Communicated by C. L. Coffin, United States.) Dated September 27th. (*Complete.*)

17,224. "Improvements in apparatus for electrically heating and working metal." W. P. Thompson. (Communicated by C. L. Coffin, United States.) Dated September 27th. (*Complete.*)

17,225. "Improvements in the method of and apparatus for electrically welding metals." W. P. Thompson. (Communicated by C. L. Coffin, United States.) Dated September 27th. (*Complete.*)

17,226. "Improvements in the method of and apparatus for welding or heating metals electrically." W. P. Thompson. (Communicated by C. L. Coffin, United States.) Dated September 27th. (*Complete.*)

17,227. "Improvements in or relating to electrically welding or heating metals." W. P. Thompson. (Communicated by C. L. Coffin, United States.) Dated September 27th. (*Complete.*)

17,242. "Improvements in electro-medical appliances." P. A. Newton. (Communicated by S. Hetherington-Carruthers, New South Wales.) Dated September 27th. (*Complete.*)

17,244. "Improvements in or relating to the supply of electricity to electrically propelled and controlled aërial machines." C. Casalonga. Dated September 27th.

17,246. "Improvements in or connected with electric primary batteries." T. J. D. Rawlins. Dated September 27th.

17,287. "A new or improved shield or cover for electric gas lighting purposes." J. Hamer. Dated September 28th.

17,299. "Apparatus for the inhalation of metals or minerals vapourised by means of electricity for medical, antiseptic, or other purposes. E. S. d'Odiardi and E. S. d'Odiardi. Dated September 28th.

17,304. "Improvements in electric heaters." T. Ahearn. Dated September 28th. (*Complete.*)

17,321. "Improvements in electric water heaters." T. Ahearn. Dated September 28th. (*Complete.*)

17,348. "Improvements in or relating to batteries." R. J. Crowley. Dated September 28th.

17,362. "An improved method of applying magnetised plates, wire, or the like, to boots and shoes." J. Pagesmith and F. Warren. Dated September 29th.

17,381. "Improvements in and relating to telephonic instruments." J. Muirhead. Dated September 29th.

17,423. "Improvements in apparatus for supplying electricity to electrically propelled vehicles." E. Chabeault. Dated September 29th.

17,438. "An improved combined electro-motor and rotary fan." F. H. Royce. Dated September 30th.

17,462. "Improvements in and apparatus for moulding earthenware electric switches, ceiling roses, bell pushes, and the like, and forming screw threads thereon." J. Meir. Dated September 30th. (*Complete.*)

17,466. "An improved electro-metallurgical process." H. C. Bull and Gustavus, Baron de Overbeck. Dated September 30th.

17,467. "Improvements in driving sewing machines by electricity." H. Lea. Dated September 30th.

17,471. "Improvements in electrical motor and fan combined for filtering and fumigating the air." S. Coxeter and H. Nehmer. Dated September 30th.

17,491. "Improvements in the application of electricity to the human body." J. Stevenson. Dated October 1st.

17,494. "Electric indicator and apparatus for cooling any part of machinery which may become heated by friction." H. W. Horne. Dated October 1st.

17,504. "Improved operating electric switch." D. Loch. Dated October 1st.

17,509. "Improvements in the construction of field magnets of dynamo-electric generators." T. R. Andrews and T. Preece. Dated October 1st.

17,526. "A magnetic water gauge or indicator of level liquid." L. Klebitz. Dated October 1st. (*Complete.*)

17,536. "Improvements in grapnels for submarine cables." E. Stallibrass. Dated October 1st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

2,046. "Improvements in and relating to electrically-propelled vehicles, especially adapted for high rates of speed." R. R. Hutchinson. Dated February 4th. The inventor employs a long car or carriage of circular, elliptical, or curvelinear cross section, each end being pointed for the purpose of reducing the surface resistance when travelling at a high rate of speed. Said car or carriage is mounted upon two or more bogie trucks or carriages, having pre-

ferably three sets of wheels upon each. Said wheels are provided with deep flanges or other equivalent device to maintain the vehicle upon the track. Upon the axle of each pair of wheels is mounted the armature of an electric motor, and a compound field magnet is arranged in such a manner that a magnetic field embraces each armature, upon the same limb or limbs, the coils being wound between said fields, thus constituting a bipolar, tripolar, or quadrupolar motor, according to the number of armatures and axles placed upon each bogie carriage.

4,588. "An improved counterweight arrangement for electric lamps." J. M. M. Munro. Dated March 14th. Consists of a roofed plate and counterweight. The cord, usually a flexible insulator twin conducting wire, which suspends the electric globe or fitting, is attached to terminals within the roof plate, from which it passes down round a pulley or counterweight, up and round another pulley in the roof plate and again down and through the counterweight emerging from the centre of the lower part of the counterweight and thence downwards to lamp or fitting. The hole through the counterweight is preferably made slightly bent or oblique, so that the slight friction between the cord and the sides of the hole assist in maintaining the counterweight at any desired height. 1 claim.

4,678. "Improvements in terminals for electrical purposes." J. Pitkin. Dated March 16th. The inventor takes steel wire from which the terminal is to be formed, and when cleaned nicely, he inserts it into a thin glass tube of suitable diameter. One end of the tube is closed, and from the other the air is exhausted by means of a pump. While thus exhausted, heat is applied to the outside of the tube, and it collapses and binds tightly on to the metal within. Steel terminals thus encased are welded into the glass bulb.

4,757. "Improvements in the electric reduction of aluminium and other metals, and in the production of alloys thereof." T. L. Willson. Dated March 17th. The invention is characterised by subjecting the ore or metal to be reduced to the action of an electric current passing from an anode of molten metal or ore beneath upwardly to a cathode of any suitable material placed above, the operation being conducted in the presence of finely-comminuted carbon as a reducing agent. 4 claims.

4,781. "A new or improved solution or electrolytic fluid for galvanic batteries." W. J. Engledue. Dated March 17th. The solution consists of the following ingredients, viz.:—Sulphuric acid (commercial), 2½ fluid ounces; hydrochloric acid (commercial), 2 fluid ounces; bichromate of soda which has been dissolved by the action of the atmosphere, or steam, 1½ fluid ounces; water, 10 ounces. 1 claim.

4,877. "Improvements relating to the production of porous materials, and to the manufacture of the same into electrodes or plates for electric batteries." H. H. Lake. (Communicated from abroad by E. A. G. Street and L. A. W. Desruelles, of Paris.) Dated March 18th. In making the improved agglomerates, the active material which is to constitute the electrode is reduced to powder or to grains of greater or less size, and is mixed with porous material, such as any porous calcareous substance which is insoluble and cannot be attacked by acids, or which may be rendered insoluble and incapable of being attacked by acids. To this mixture is added albumen, or a substance containing albumen, in suitable proportions, which may be varied according to the character of the active material employed in the electrode. After the intimate mixture of the substances above named, the mass is moulded under pressure or by passing it through dies, or in any other convenient manner, to impart to it the desired form. After this moulding operation, the agglomerate is introduced into a stove or other heating apparatus, and is heated to a suitable temperature, which has the effect of coagulating the albumen, thus rendering it insoluble and enabling agglomerates of great strength to be obtained and to be shaped as required. 2 claims.

4,988. "Improvement in type printing instrument for telegraphic purposes." W. Thompson. Dated March 20th. Relates to a dynamo or magneto type printing telegraphic instrument, standing upon legs similar to a small foot lathe, and driven by the foot of the operator by means of a pedal; the keyboard and receptor are on the top of the instrument. The printing is done mechanically on a band of paper. 11 claims.

CORRESPONDENCE.

Water Wheels.

Will the author of the excellent papers on water-wheels kindly state the most effective diameter for a Poncélet wheel, according to the volume of the stream and the fall?

For instance, what should be the diameter of such a wheel on a stream whose flow is 1,280 cubic feet per minute (viz., a depth of 4 inches passing over a weir 31 feet long) where there is an available fall of 5 feet in summer, and 3 feet 6 inches in winter at flood time?

At first sight it would seem as if the greater the diameter of the wheel, the greater would be the power exerted by the weight of water and its impulse, at the end of a long lever. On the other hand, the larger the wheel, the more slowly it must rotate with a given current.

Ajax.

"F.T.S."

It may interest a correspondent of yours to learn that it is illegal for any person to assume the title of "Fellow" of any society unless such society has been duly incorporated either by Royal Charter or by a separate Act of Parliament. I do not say that any definite penalty is incurred by an individual who assumes such a distinction; but no one certainly will thus add to his own standing or to that of the society which sanctions such a line of conduct.

J. W. S.

Expense of Up-keep of Batteries and Electrical Gear of Tramcars.

We have pleasure in calling your attention to the enclosed circular letter which we are now issuing to the chief tramway companies in Great Britain, and which is the best possible answer to the criticism that has lately been made on the expense for up-keep of batteries and electrical gear of tramcars.

The Electrical Power Storage Company, Limited.

Frank King, *Manager.*

October 7th, 1892.

[Copy of Circular Letter.]

Electrical Power Storage Company, Limited,
4, Great Winchester Street, London, E.C.

October, 1892.

Dear Sir,—We beg to call your attention to the fact that we are now prepared to negotiate for the working and maintenance of approved tram lines equipped with self-contained or storage electric cars.

The terms under which such working and maintenance can be contracted for necessarily vary with local conditions, but the maximum charge would be 66 per cent. of the gross traffic receipts.

You will readily note that such an undertaking should and does constitute the most effectual guarantee of perfection of service, and we shall be pleased to discuss the matter further with you at any time.

Yours faithfully.

Magnetism and "Magnetism."

Your leaderette writer acknowledges his inability to explain what magnetism is, by challenging me to first explain what gravitation is. This, to me, seems rather a poor way of getting out of an argument. *Most* writers seem to have a peculiar style of entangling themselves in a net, and then trying to wriggle out and leave an impression that he knows and understands what he is talking about, and, of course, nobody else does.

I don't see why he should have felt hurt when Mrs. Besant called mesmerism magnetism, seeing that he does not know what magnetism is. He recommended Mrs. Besant to a course of *elementary* training at South Kensington. But since those at South Kensington would be unable to explain to her what magnetism is, I don't see what benefit it would be to her on the subject. He says as much as that Mrs. Besant is ignorant of the theory as to what magnetism really is; and since he acknowledges himself unable to enlighten her on the point, perhaps he himself would be able to get enlightened by taking a course of lessons at the Institute he recommends so readily to other people.

He asks if I can tell what gravitation is? I don't say I can, but rather than try to "back out" by asking him a more puzzling question, I am willing to try my best to explain what gravitation is more satisfactorily than he can explain what magnetism is.

The sore spot seems to lay here: There seems to be a lot of "self-styled" scientific men who are determined to make themselves eminent. They have not the power to make any new discovery themselves, so they point out some old and almost forgotten idea and claim it as their own discovery. And when some honest man *or woman* comes up and shows that the theory has been preached centuries ago, they don't like it, and seize the first opportunity of having a little revenge out of the exposer.

Will the writer of the leaderettes *try* to explain what magnetism is? If he will do this, I will try how far I can go to explain what gravitation is, and perhaps, also, give my idea of magnetism. Only don't answer by asking another question. It isn't manly. Surely the subject would be sufficiently interesting.

Harry Austin.